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ABSTRACT

Descriptions of new developments in the areas of facilities, applications, user services, support staff, research, evaluation, and courseware production since the Second Summative Report (1977) are provided, as well as a summative overview of PLATO applications at the University of Delaware. Through the purchase of its own PLATO system, this university has become the first institution to offer comprehensive PLATO services on the east coast. New applications in accounting, anthropology, chemical engineering, honors, mathematics, military science, and security have brought the number of departments using PLATO to a total of 28. The project has also laid the groundwork for the publication of its PLATO materials on the national CDC PLATO network, and lessons have been produced for publication in the areas of agriculture, art, counseling, education, human resources, languages, music, nursing, psychology, and system utilities. Divided into three main sections, the report covers project history and development, departmental applications, and evaluation. A catalog of courseware under development at Delaware is appended. (Author/JEG)

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Third Summative Report of the Delaware PLATO Project

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by

Fred T. Hofstetter

July 1, 1978

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University of Delaware
PLATO Project

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INTRODUCTION

Since the writing of last year's Second Summative Report of the Delaware PLATO Project (Newark: University of Delaware PLATO Project, 1977), several important developments have occurred in the areas of facilities, applications, user services, support staff, research, evaluation, and courseware production. Through the purchase of its own PLATO system, the University of Delaware has become the first institution to offer comprehensive PLATO services on the east coast. The number of on-campus terminals increased from 32 to 50, and the University's first external PLATO customers began to access the machine. An office building was refurbished in order to accommodate the growing number of PLATO staff members, and several new terminal sites were established in order to make PLATO more accessible to academic departments.

New applications were begun in accounting, anthropology, chemical engineering, honors, mathematics, military science, and security. These new applications brought the number of departments using PLATO to a total of twenty-eight. The PLATO support staff was increased in order to support the new departments, and two new managerial positions were created to assist in the supervision of the new staff members and the new PLATO system. The research and evaluation components of the project were more productive, with perceptual studies in educational foundations, a comprehensive study of student opinions toward PLATO, and controlled evaluations of student performance in physical education, languages, and music.

The University of Delaware PLATO Project also laid the groundwork for the publication of its PLATO materials on the national CDC PLATO network. A courseware contract was negotiated and signed whereby the University will receive royalties in return for the use of its materials on other PLATO systems, and an author agreement was formalized whereby University faculty, staff, and students who contribute to the development of PLATO materials can share the distribution of royalty income. The project has produced lessons ready for publication in the areas of agriculture, art, counseling, education, human resources, languages, music, nursing, psychology, and system utilities.

Since this report serves the dual purpose of not only recording new events which have occurred since the last report, but also providing a summative overview of PLATO applications at the University of Delaware for prospective new PLATO users, it will include not only new developments but also pertinent information from previous reports of the Delaware PLATO Project. It is divided into three main divisions: project history and development, departmental applications, and evaluation. Following these is an appendix which contains a catalog of courseware under development at Delaware. Grateful acknowledgement is made to Professor Ray Nichols of the University's Art Department for producing the photographs used in this report, and to Jill Cypher for the cover art work.

CHAPTER I. HISTORY AND DEVELOPMENT OF THE DELAWARE PLATO PROJECT

-Background-

The Delaware PLATO Project originated in the Fall of 1974 during deliberations of the university's computer applications to education committee. The committee planned a series of seminars and demonstrations for the purpose of making available to the Delaware faculty information on how a computer-based educational system may function in a university, and of evaluating what part such a system might play in the future of the university and its supporting community. A major portion of the committee's planning consisted of the review and selection of a computer-based educational system which could support the demonstration. The criteria used in making the selection provide a summary of the reasons why PLATO was chosen for the demonstration. They required that the demonstration system contain:

1) An overall system design which can support many instructional strategies such as gaming, simulations, testing, drill-and-practice, and self-paced programmed instruction.

2) An existing library of demonstration programs encompassing many academic areas.

3) A programming language which is both easy for faculty members to learn, and at the same time powerful enough to support instructional computing.

4) A student record-keeping capability to support educational research in learning behaviors.

5) High-speed interactive graphics for both textual and pictorial displays.

6) A very good overall system reliability.

The first terminal was installed at the university on March 14, 1975. A committee of faculty members selected from seventeen academic areas coordinated demonstrations of PLATO for each of the respective areas, encouraged interested faculty members to enroll in a seven-week seminar on author training, and solicited proposals from each college regarding the implementation of existing courseware and/or the development of new PLATO programs. By the end of May, nine departments had proposed to develop materials and try out PLATO with students.

During the summer of 1975 the proposals were approved, and the university ordered seven additional PLATO terminals to support program development. The first full-time professional PLATO programmer/analyst was hired to teach

PLATO seminars and assist faculty members with difficult programming problems, and eight part-time student programmers were employed to help write programs for individual departments. The project was held back somewhat by the amount of lead time needed to procure the additional PLATO terminals. One terminal was available right away, and was installed in September of 1975. However, the other six took longer to procure and were not installed until February of 1976.

This delay prevented large scale development of PLATO programs during the Fall of 1975, when the two available terminals were used mainly for lesson review, demonstrations, author training, and planning the development of new material. During this period the faculty committee refined its PLATO proposals, and made plans for the first large-scale use of PLATO with Delaware students to begin during the Fall semester of 1976. On February 2, 1976, the committee submitted a proposal requesting the procurement of 24 terminals for student use. On April 28, 1976, this proposal was approved.

During the Spring and Summer of 1976, the faculty continued to prepare materials for student use. Utilization of the eight authoring terminals was high, averaging about sixty hours per terminal per week. PLATO continued to generate new interest, and by the beginning of the Fall semester there were sixteen departments planning to use the student terminals. However, the project was held back again due to the long lead time needed to order terminals and the care which had to be taken in negotiating a fair services contract for the university. In September the project grew to a total of 12 terminals to support both development of programs and student use of PLATO during the Fall semester of 1976. It was not until March 15, 1977, midway into the Spring semester of 1977, that the project reached the desired level of 24 student terminals and 8 authoring terminals.

During the summer and fall of 1977, faculty members began to use PLATO in larger portions of their classes. In addition, the PLATO Project generated new interest in departments which had not previously used PLATO. The number of departments involved increased to a total of twenty-eight, and the average utilization of the thirty-two terminals exceeded sixty hours per terminal per week. In order to serve the dual purpose of reducing the level of frustration in getting to a PLATO terminal by lowering the average number of hours each terminal was used per week, and also to provide some growing room for the departments which had just begun using PLATO, it was decided to increase the number of terminals from thirty-two to fifty in preparation for the spring semester of 1978. Increasing the project to a level of fifty terminals brought the University to a decision point regarding the future of the Delaware PLATO Project, because cost analyses had shown that once the project grew to above forty-eight terminals it would become more economical for the University to purchase its own PLATO system than to lease services by means of long-distance communications lines. Based on the steady growth which the project had enjoyed since its beginning in March of 1975, and based on the encouraging results from controlled evaluations and studies of student opinions regarding the usefulness of PLATO in higher education, the University of Delaware purchased its own PLATO system from the Control Data Corporation.

The new Delaware PLATO system uses the latest line of computer hardware offered by the Control Data Corporation. Based on a Cyber 173 mainframe, it is configured to serve a load of 100 simultaneous PLATO users. Eventually it can be expanded to serve over 1,000 users. In its present configuration, one central processor and ten peripheral processors operate with 98,000 60-bit words of central memory. In addition, the machine is equipped with 500,000 words of ECS-II (extended core storage), four dual-density disk drives, two tape drives, and two remote job entry stations.

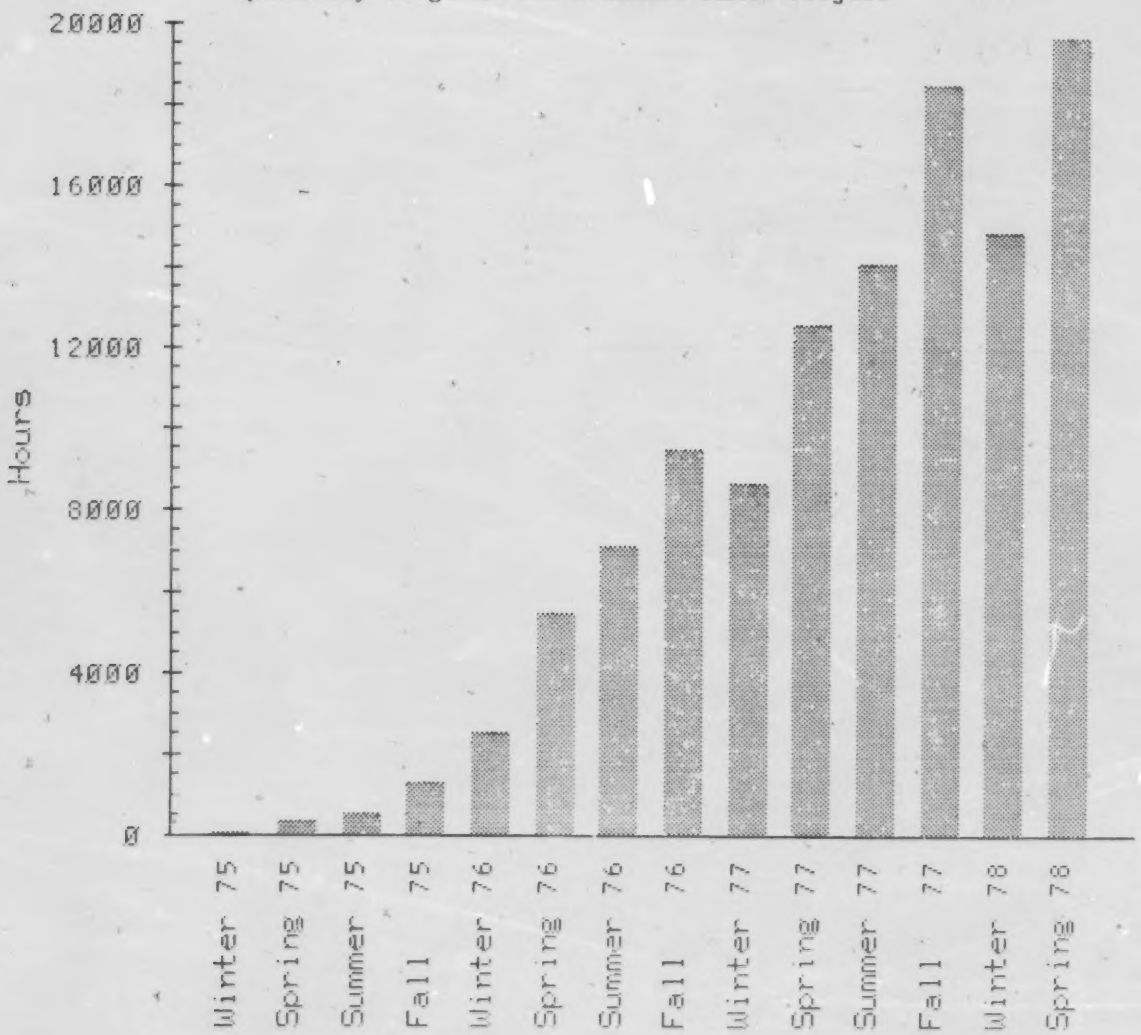
The University of Delaware Computing Center did an excellent job in preparing for the installation of the machine. A large area in the newly constructed Computing Center was designated for the PLATO system. Power generators were installed, a chilled water system was engineered, and the necessary electrical lines and pipes were put into place for the machine. The system was delivered at the University of Delaware Computing Center on January 31, 1978. After the machine was assembled, powered up, and run through a long series of performance tests and acceptance tests, it was officially accepted on St. Patrick's Day, March 17, 1978.

The Delaware PLATO system is linked into a worldwide PLATO network which allows Delaware authors to exchange materials and ideas with other users on systems in Minnesota, Illinois, Quebec, and Brussels.

From the beginning of the project there has been a steady rise in the utilization of PLATO at the University of Delaware. Figure 1 shows the growth in terms of hours of terminal usage per quarter. The sharpest rise in utilization occurred during the first two quarters of 1976, when serious development of new programs began. The average utilization tripled during the 1976-77 academic year, when large-scale use by students began. It was at that time that the average utilization rose to over eighty hours per terminal per week. Additional interest shown in PLATO during the 1977-78 academic year produced a level of utilization which was almost twice that of 1976-77. Karna Mathre, a PLATO Project staff member majoring in business and economics, produced as a senior project an economic forecast for PLATO use at the University of Delaware through 1979. According to this forecast, use by University of Delaware faculty members and students is expected to continue at a fairly constant rate, increasing by a factor of about 1.7 each year.

Figure 1

Quarterly Usage of the Delaware PLATO Project



The Second Summative Report of the Delaware PLATO Project contained a list of forty-eight courses in which PLATO was used during the 1976-77 academic year. Table 1 of this report shows how the number of courses grew to a total of sixty during the 1977-78 academic year. Column 1 gives the course symbol and number from the University's course catalog. Column 2 contains the descriptive title for the course. Column 3 gives the number of credits. Column 4 shows how many students used PLATO in the course. Column 5 gives the average number of hours each student used PLATO. The last four columns indicate whether the course used PLATO in the summer session, the first semester, the winter session, or the second semester. 3,163 students in sixty courses used PLATO during 1977-78. They accumulated a total number of 14,880 hours spent at PLATO terminals.

Table 1

Courses Using PLATO During 1977-78

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
APS 101	Animal Science	4	120	1.6		X		
APS 133	Anatomy and Physiology	4	111	7.4		X		
APS 134	Anatomy and Physiology	4	89	7.7				X
APS 341	Genetics of Farm Animals	4	53	9.7		X		
APS 641	Reproductive Physiology of Domestic Animals	3	13	1.4		X		
ART 121	Design I	3	79	5.1		X		
ART 200	Typography	3	70	10.7	X	X		
ART 241	Printmaking I: Silkscreen	3	35	5.2	X	X		
ART 303	Visual Design & Communication	3	21	16.1		X		
C 101	General Chemistry	4	91	2.9				X
C 111	General Chemistry	3	177	6.4		X	X	
COM 251	The Development of Language & Speech	3	12	3.0		X		
COM 275	Phonetics	3	29	2.9				X
E 011	English Essentials	3	2	1.9				X
EC 101	Introduction to Economics	3	44	2.3		X		
EC 102	Intro to Economics II	3	16	1.4				X
EDC 372	Elementary School Arithmetic	3	86	1.8		X		X
EDC 534	Workshop in Elementary Education	3	4	1.0				X

Table 1 (Continued)

Courses Using PLATO During 1977-78

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
EDC 560	Teaching Elementary Math	3	21	1.8	X			
EDC 624	Analysis of Reading Retardation	3	8	3.4		X		
EDC 667	Teaching Algebra by Computer	3	14	0.8	X			
EDF 209	Psychological Foundations of Ed.	3	34	0.5				X
EDF 410	Educational Psychology	3	19	4.6		X		
EDF 665	Elementary Statistics	3	4	1.8		X		
EDF 861	Data Analysis I: Intro to Stat. Inference	3	20	3.5		X		
EDO 381	Methods of Teaching Secretarial Studies	3	16	3.7		X		
EDO 382	Methods of Teaching Bookkeeping Subjects	3	16	2.5				X
EDO 467	Intro to Computers in Occup. Education	3	15	2.5		X		
EDO 667	Workshop in Computer Instruction: Business Teaching	3	25	1.0	X			
EDP 331	Career Exploration Training	1	10	1.5		X		
EDP 567	Computer-Based Ed. - PLATO	3	9	23.2	X			

Table 1 (Continued)

Courses Using PLATO During 1977-78

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
EDP 653	Occupational and Educational Info	3	5	1.5		X		
FHP (Freshman Honors Program	Introduction to Experimental Psychology	3	40	7.5		X		X
FR 102	Elementary French II	3	58	3.7		X		X
GK 101	Elementary Greek	3	19	4.3		X		
LAT 101	Elementary Latin I	3	11	2.4		X		
MIL 405	Military Science	2	21	2.9		X		
M 113	College Algebra	3	22	1.5				
M 117	Integrated Algebra and Trigonometry	4	5	1.8				X
MU 105	Fundamentals of Music I	3	229	5.9	X	X	X	X
MU 106	Fundamentals of Music II	3	7	2.9				X
MU 110	Chorale	1	25	2.1				X
MU 185	Music Reading - Ear Training I	2	72	16.8	X	X		
MU 186	Music Reading - Ear Training II	2	45	13.8		X	X	X
N 301	Nursing: Adult Physical Health & Illness I	10	147	2.5		X		X
N 366	Clinical Experience	1	63	10.7		X		X

Table 1 (Continued)

Courses Using PLATO During 1977-78

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
					Summer	Fall	Winter	Spring
N 406	Nursing in Adult Physical Health & Illness II	10	29	4.1		X		X
N 466	Special Problem	1	1	7.6		X		
PE 426	Biomechanics Lab	3	67	11.9		X	X	X
PE 608	Curriculum in Phys. Ed.		7	1.5	X			
PE 612	Mechanical Analysis of Sport Skills	3	7	.3		X		
PLS 101	Botany of Economics Plants I	4	180	2.5		X		
PSY 201	General Psychology	3	193	4.0	X	X		
PSY 312	Learning and Motivation	3	99	2.3	X	X		X
SP 101	Elementary Spanish I	3	31	2.8				X
TC 466	Special Problem: PLATO Review	1	36	5.7		X		X
	Counseling Center Use of Career Search		374	1.5	X	X	X	X
	Reading Study Center		40	.7		X		
	English Grammar Review for Latin & Greek Students		17	2.6		X		
	Writing Center		40	7.5		X		X
	Honors: Computer-Based Education	1	10	8.9				X

-Organization-

There are two main components in the organization of the Delaware PLATO Project. The first is its division according to academic departments requesting the use of PLATO services. The second is the approach taken by its staff in order to provide those services. In each department there is a faculty member identified as "PLATO project leader." The project leader serves as an intermediary between the PLATO staff and the rest of the faculty in the department. The project leader coordinates all PLATO activities for the department, including evaluation. All final decisions regarding the content of PLATO lessons are made by the project leader. Most project leaders use a peer review process whereby they obtain help from their colleagues in making these decisions. The energy, enthusiasm and dedication of the faculty has been a very important factor in the implementation of PLATO at the University. Table 2 contains a list of the PLATO project leaders.

Table 2

PLATO Project Leaders at the University of Delaware

Department	Project Leader
Agriculture	Donald Fieldhouse
Art	Raymond Nichols
Chemical Engineering	Robert Pigford and Stanley Sandler
Chemistry	John Burmeister and Evelyn Stevens
Civil Engineering	Eugene Chesson
Communications	George Borden
Continuing Education	Richard Gearhart
Counseling	Richard Sharf
Curriculum & Instruction	John Brown and John Pikulski
Economics	James O'Neill
Educational Foundations	Victor Martuza
Freshman Honors Program	Donald Harward
Home Economics	Frances Mayhew
Latin	Gerald Culley
Mathematics	Ronald Wenger
Military Science	George Bailey
Music	Michael Arenson
Nursing	Mary Anne Early and Don Mackay
Occupational Education	James Morrison
Physical Education	David Barlow and James Kent
Physics	Cheng-Ming Fou
Professional Services	John Gaynor
Psychology	John McLaughlin
Reading Center	Peter Pelosi
Security	Stephen Swain
Statistics & Computer Science	Hatim Kahlil
Theatre	Brian Hansen
Upward Bound	William Morris
Writing Center	Louis Arena

As requests for the use of PLATO have increased, the University has developed a highly trained staff to support the project. At the beginning of the project the staff consisted of three graduate assistants. When the faculty's request for expansion to a level of eight terminals was approved in the summer of 1975, a senior applications programmer/analyst became the first professional staff member of the project, and the number of student assistants was increased to eight. During the summer of 1976, in preparation for large-scale student use of PLATO, a second professional programmer/analyst was hired, and the number of student assistants was increased from eight to twelve. During the winter of 1976-77, six of the student assistants demonstrated that they had met the qualifications for junior staff positions, and they were promoted to junior PLATO applications programm/analysts.

During the 1977-78 academic year four more student assistants demonstrated that they had met the qualifications for junior staff positions, and they were similarly promoted to junior PLATO applications programmer/analysts. In addition, three new professional analysts were hired from outside the University, two at the junior level, and one at the middle level. Two systems programmers were hired in order to coordinate system programming, operations, and communications for the new machine. A second secretary was hired to handle the increased load of paper work in the project. Finally, funds sufficient to hire one full-time operator were allocated to the University of Delaware Computing Center which is operating the new PLATO machine.

During the past year the two senior staff members of the Delaware PLATO Project, namely, James H. Wilson and Bonnie A. Seiler, have been taking on more and more of a supervisory role. In addition to overseeing the work of several junior staff members, they each have a major managerial component of the project. Bonnie Seiler is in charge of lesson design, evaluation, and scheduling, and Jim Wilson manages the operations side of the project. Recognizing the increased level of responsibility of these two staff members, two new managerial positions were created, and Bonnie and Jim were promoted to these positions effective July 1, 1978. Table 3 shows a complete list of the staff of the Delaware PLATO Project. The codes given in column 3 are used to identify each staff member in the project's task assignment chart which is discussed on the next page.

The number of tasks needed to support program development, experimentation, student use, and evaluation for the many departments using PLATO requires that each staff member of the PLATO Project carry out multiple assignments. Figure 2 contains the task assignment chart of the Delaware PLATO Project. It shows how staff members have assignments at two different levels, namely, program development and supporting services. In program development each staff member is assigned to write programs for one or more departments. In addition, each staff member assumes one or more additional roles under supporting services which include operations, site management, library cataloging, TUTOR training, scheduling, lesson design and evaluation.

Operational duties include the running of the Delaware PLATO system; the management of files such as instructional programs, utility routines, and work spaces in the computer memory; maintenance of terminals and peripheral equipment; data storage and transfer from PLATO to the University's computers and vice versa; and printing of graphic displays and data files as requested by the faculty. Each established PLATO site is watched over by a PLATO staff member who insures that the physical environment is conducive to student learning and to safe operation of the equipment. The site director also insures that the terminals are not using more than their proper allocations of computer resources. To date PLATO sites have been established in the Education Building, in Smith Hall, at 46 E. Delaware Avenue (PLATO staff building), in Music, in Chemistry, and in the Computing Center.

The PLATO Library consists of four main parts. First, print materials, which include all available publications dealing with PLATO and significant publications by users of other systems; second, audio disks, which store up to twenty-two minutes of pre-recorded audio materials for use with PLATO's random access audio device; third, microfiche slides, which contain up to 256 slide images which can be rear-projected onto the screen of the PLATO terminals; and fourth, 35mm color slides of PLATO displays, facilities, and related materials, which are used in demonstrations and other presentations. A comprehensive TUTOR training program is maintained in order that staff members can increase their programming abilities, and so that prospective authors of new PLATO lessons can learn the authoring language. Now that microprocessors are becoming an important component in the PLATO system, a committee has been established which is studying available microprocessor systems, establishing a training program for use in the University and in the state, and designing a communications system whereby microprocessors can use the PLATO system to exchange electronic mail, get new versions of programs, and report back to the central system concerning student performance. Code review and lesson review sessions are held regularly in order to maintain the high quality of lesson development which has become a standard in the Delaware PLATO Project. Seminars are held regarding techniques of educational design and evaluation, and a catalogue of test instruments is kept with examples of their applications. Several staff members share the responsibility of providing consultation to users in the PLATO classrooms.

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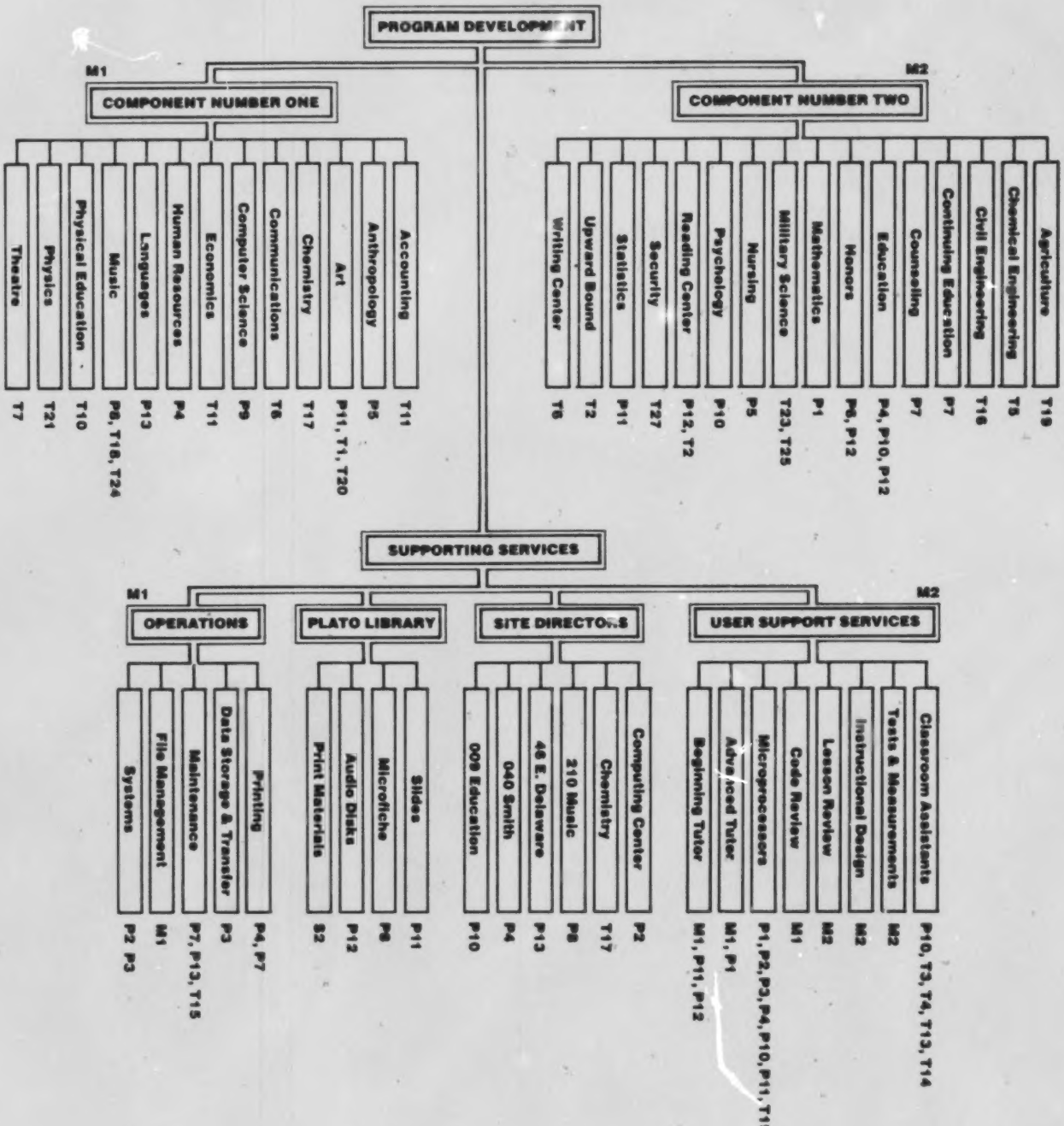
FIGURE 2

TASK ASSIGNMENT CHART



Abbreviations used in this chart are given in Table 3.

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Table 3

Staff of the Delaware PLATO Project

Position	Name	Code
Director	Fred T. Hofstetter	D
Assistant Director	Marianna K. Preston	A
Senior Secretary	Joan Harris	S1
Secretary	Charlotte Coletta	S2
Manager	James H. Wilson	M1
Manager	Bonnie A. Seiler	M2
Programmer/Analyst	Keith Slaughter	P1
Systems Programmer	Brand Fortner	P2
Systems Programmer	Charles Wickham	P3
Junior Analyst	Dave Anderer	P4
Junior Analyst	Monica Berrang	P5
Junior Analyst	Christine Brooks	P6
Junior Analyst	Mark Laubach	P7
Junior Analyst	William Lynch	P8
Junior Analyst	Joe Maia	P9
Junior Analyst	Judith Sandler	P10
Junior Analyst	James Trueblood	P11
Junior Analyst	Jessica Weissman	P12
Junior Analyst	Dan Williams	P13
Trainee Staff*	Klaus Abele	T1
Trainee Staff	Deborah Braendle	T2
Trainee Staff	William Childs	T3
Trainee Staff	Tuan Duong	T4
Trainee Staff	Doug Harrell	T5
Trainee Staff	Michelle Heineman	T6
Trainee Staff	Michael Larkin	T7
Trainee Staff	Carol Leefeldt	T8
Trainee Staff	Sam Luu	T9
Trainee Staff	Stuart Markham	T10
Trainee Staff	Karna Mathre	T11
Trainee Staff	Janet Niland	T12
Trainee Staff	Thang Nguyen	T13
Trainee Staff	Christopher Pfister	T14
Trainee Staff	William Resnicow	T15
Trainee Staff	Jeff Snyder	T16
Trainee Staff	Elli Summers	T17
Trainee Staff	Richard Thomas	T18
Trainee Staff	Daniel Tripp	T19
Trainee Staff	Ben Williams	T20
Trainee Staff	James Alwood	T21
Trainee Staff	Telesforo Carrera	T22
Trainee Staff	Mike Houghton	T23
Trainee Staff	Russ Kozerski	T24
Trainee Staff	Thomas Noyes	T25
Trainee Staff	Brian Russell	T26
Trainee Staff	Ray Schwartz	T27

* all Trainee Staff are miscellaneous wage earners. Five of these are work-study students. Trainee Staff listed below the dotted line are funded by departments other than PLATO.

-Instructor and Author Training-

A series of weekly seminars is offered four times a year in order to give members of the university and its surrounding community an opportunity to learn about various aspects of the PLATO system. There is a short orientation seminar for those who want a brief overview, a sequence of two courses in TUTOR programming, a course in lesson design, a lesson review seminar, and a research and development seminar. These seminars are offered free of charge for no credit to members of the University of Delaware. In addition, a computer-based education seminar is taught through the College of Education for those wishing to earn graduate credit. A special fee structure has been established for those outside the University community who wish to take advantage of this training curriculum. Persons interested in pursuing this should request a copy of the Delaware PLATO Services Brochure.

Table 4

Training Curriculum for Users and Authors

1. General Orientation to the PLATO System. Three lecture-discussions outlining general purposes and uses of the PLATO system. Includes inspection of existing instructional programs, use of communications features for monitoring student progress, and guidelines for considering the use of PLATO in your own instruction and educational research.

2. Beginning TUTOR Programming. Ten lecture-discussions emphasizing the fundamentals of TUTOR, PLATO's programming language. Intended for those who have little or no background in computers. Allow two to four hours per week for practice at a terminal.

3. Intermediate TUTOR Programming. Ten one-hour discussions emphasizing advanced topics in PLATO programming. Prior knowledge of TUTOR is a prerequisite. Allow two to four hours per week for practice at a terminal.

4. PLATO Lesson Design. Ten workshops for those who will be making design decisions and/or implementing them for PLATO lessons. Emphasis will be on examining existing lessons for display techniques, answer handling, mode of instruction, organization, and style. Participants will design small modules of instruction and practice making decisions at different stages of lesson development. Faculty and programmers may wish to work together.

5. PLATO Research and Development. An on-going, informal seminar intended to provide a forum for the exchange of ideas among developers of PLATO programs at the University of Delaware. Topics include lesson design, programming, implementation, evaluation, and experimentation.

6. PLATO Lesson Review. An informal weekly review of lessons currently being developed at Delaware. Emphasis is on improving our instructional materials through on-going analysis and discussion with the lesson authors.

7. Special Topics Sessions. Any department or other group that is interested in a particular topic, such as using PLATO for research or examining lesson material in a given subject area, may wish to arrange one or more special sessions at the convenience of the participants.

8. EDP 567 Seminar: Computer Based Education - PLATO (3)
General introduction to the use of computers in instruction and to the development of computer-based lessons on the PLATO system. Includes discussions of hardware configurations, modes of instruction, the processes of implementation and validation, and reviews of many existing projects throughout the country. Considers the design of lessons and the structure of the TUTOR language.

Since the beginning of the project a growing number of teachers from Dealware's public schools have become interested in using PLATO in the classroom. In response to their requests for an opportunity to learn more about computer-based education, a Summer Institute in Computer-based Education was held during July of 1976. Jointly funded by the University and the Delaware School Auxiliary Association, the institute offered instruction on PLATO and on Project DELTA, a mini-computer based system with terminals in many of Delaware's high schools. In addition, all participants attended a seminar to discuss issues raised in the new book by Hunter et al., Learning Alternatives in U.S. Education: Where Student and Computer Meet (Englewood Cliffs: Educational Technology Publications, 1975).

Special presentations were made by participating faculty from several disciplines. There included art, presented by Ray Nichols of the University's Art Department; physics, by Richard Herr of Physics; lesson design, by Bonnie Seiler of the PLATO staff; computer-assisted testing, by Robert Uffelman of Education; music, by Fred Hofstetter of Music; computer-managed instruction and vocational-technical training, by John Matthews and Ed Boas of Education; administrative computing, by John Falcone of the Computing Center; MENTOR, by Hank Hufnagel of the Computing Center; WANG minicomputers, by Derryl Pelley of the Mathematics Department at Glasgow High School; chemistry, by Henry Blount of the Chemistry Department; DELTA, by Teresa Green of the University's DELTA Project; and PLATO, by Jim Wilson of the PLATO staff. Many of the participants in the institute have gone on to develop, test, and implement computer programs in their respective schools.

A second Summer Institute in Computer-Based Education will be held from July 24 through August 11, 1978, under a $30,000 grant from the National Science Foundation. In addition to the activities included in the 1976 Institute, the NSF Institute will also include a section on mathematics by Professor Ron Wenger, and one on Social Science by Professor Vivian Klaff. Whereas the 1976 Institute was for Delaware teachers only, the 1978 Institute will include teachers from Pennsylvania, Maryland, and New Jersey, in addition to teachers from Delaware.

-Lesson Review-

New users usually begin their orientation to PLATO by reviewing some of the more than 2000 hours of lesson materials that already exist on the PLATO system. The ever-increasing PLATO lesson library is organized into twenty subject matter catalogs and is accessible from any PLATO terminal. In addition, comprehensive wirtten guides to lesson materials are available in the PLATO library, located at 46 E. Delaware.

Potential users may review PLATO lessons in their field in order to consider them for use by their students and/or to provide ideas for new lessons of their own. Sampling lessons written for subjects outside the teaching areas of the reviewer can also lead to ideas for applications in the reviewer's own subject.

Another early step in becoming acquainted with the features of the PLATO system involves trying various terminal accessories such as the random access audio device, which presents pre-recorded messages; the four-voice music box; the Votrax digitized speech device; and the random access slide projector.

In order to facilitate the review of lessons by faculty, staff, student, and visitors, a special "demonstration" sign-on has been created which gives all users immediate and easy access to the lessons on PLATO. Instructions for using this sign-on are as follows. First, when PLATO asks for your name, type "demo" as shown in Figure 3 and press the NEXT key; second, when PLATO asks for your course, type "demo" as shown in Figure 4 and while holding down the SHIFT key press the STOP key. PLATO will then display a nine-page index which accesses most of the instructional materials on PLATO. This index is shown in Figure 5. Reviewers can try a lesson by typing the appropriate letter from the index.

Three PLATO lessons were written specifically to orient new users to the Delaware PLATO System. They included: "How to Use PLATO," which teaches the new user how to operate the terminal; "Seminars Offered about PLATO," which describes the seminar series offered four times a year by the PLATO staff; and "Information on PLATO in Delaware," which displays tables and graphs on monthly terminal use, projected costs, and departmental involvement. These three lessons are accessible from the first page of the demonstration index.

Figure 3. Signing on for Lesson Review: The Name.

Type the name of your PLATO course (group). Then, while
holding down the SHIFT key, press the STOP key.
When you are ready to leave, you should press
these same keys (SHIFT-STOP) to "sign off".
> demo

Figure 4. Signing on for Lesson Review: The Course.

WELCOME TO PLATO
Special features of the system:
a Pizza: Fractions
--uses the touch panel
b Intervals Ear Training Game
--uses the music box
c Elevator: The Words "up" & "down"
--uses the audio device
d Qualitative Organic Analysis
--an example of interactive dialogue
Lessons about the PLATO SYSTEM
e How to Use PLATO
--very helpful for firsttime users
f Seminars Offered about PLATO
g Information on PLATO in Delaware
The next 8 pages include samples of lessons
in the sciences, math, art, music, languages,
education, medicine, and other subject areas.
(Press NEXT for Science lessons)
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation

Figure 5 (a). Index of Programs for Lesson Review.

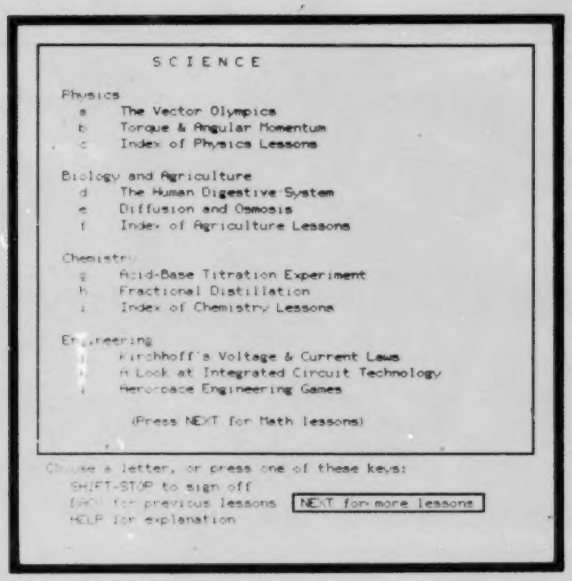
SCIENCE
Physics
a The Vector Olympics
b Torque & Angular Momentum
c Index of Physics Lessons
Biology and Agriculture
d The Human Digestive System
e Diffusion and Osmosis
f Index of Agriculture Lessons
Chemistry
g Acid-Base Titration Experiment
h Fractional Distillation
i Index of Chemistry Lessons
Engineering
j Kirchhoff's Voltage & Current Laws
k A Look at Integrated Circuit Technology
l Horoscope Engineering Games
(Press NEXT for Math lessons)
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation

Figure 5 (b). Index of Programs for Lesson Review.

MATH
Elementary Math
a Darts (number line)
b Pinball (+-*= facts game)
c Pitcher Pouring Problems
d Index of Elementary Math Lessons
Mathematics
e Polar Coordinates
f Matrix Calculator
g Index of Mathematics Lessons
Computer Science
h FORTRAN--Intro. to DO Loops
i BASIC--Intro. to BASIC
j APL--An Intro. to APL
k Index of Computer Science Lessons
Statistics
l Basic Statistical Package
m Binomial Distribution
(Press NEXT for Art and Music lessons)
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation

Figure 5 (c). Index of Programs for Lesson Review.

ARTS
Music
a Note Reading Game
b GUIDO Ear Training Lessons
--use with the music box
c FLICKS--use with the music box
d Musical Terms for Student Conductors
e Index of Music Lessons
Graphic Art & Design
f SQUARE--an Experiment in Design
g Roses--String Pictures
h Grey Scale
i Unit Design--Art Project
j Index of Art and Graphics Lessons
Press NEXT for Language & Reading lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation

Figure 5 (d). Index of Programs for Lesson Review.

Figure 5 (e). Index of Programs for Lesson Review.

Figure 5 (f). Index of Programs for Lesson Review.

MEDICAL SCIENCE
Medicine
a Poisons and Noxious Drugs
b Emergency Patient Management Simulation
Nursing
c Pediatric Pharmacology for Nurses
d Care of Postoperative Patients
e Index of Nursing Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation

Figure 5 (g). Index of Programs for Lesson Review.

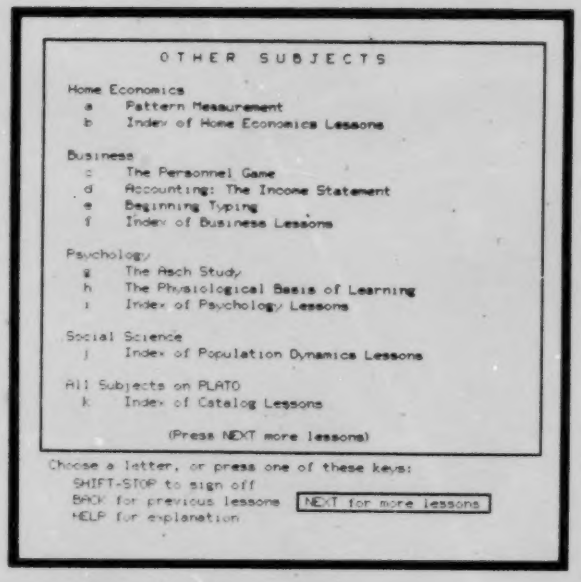
OTHER SUBJECTS
Home Economics
a Pattern Measurement
b Index of Home Economics Lessons
Business
c The Personnel Game
d Accounting: The Income Statement
e Beginning Typing
f Index of Business Lessons
Psychology
g The Asch Study
h The Physiological Basis of Learning
i Index of Psychology Lessons
Social Science
j Index of Population Dynamics Lessons
All Subjects on PLATO
k Index of Catalog Lessons
(Press NEXT more lessons)
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation

Figure 5 (h). Index of Programs for Lesson Review.

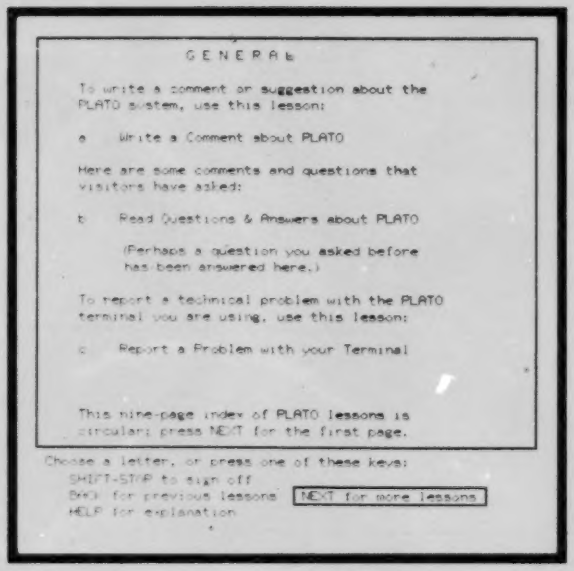
GENERAL
To write a comment or suggestion about the PLATO system, use this lesson:
a Write a Comment about PLATO
Here are some comments and questions that visitors have asked:
b Read Questions & Answers about PLATO
(Perhaps a question you asked before has been answered here.)
To report a technical problem with the PLATO terminal you are using, use this lesson:
c Report a Problem with your Terminal
This nine-page index of PLATO lessons is circular; press NEXT for the first page.
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
BACK for previous lessons
NEXT for more lessons
HELP for explanation

Figure 5 (i). Index of Programs for Lesson Review.

-Participation in ADCIS-

The Delaware PLATO Project is an active participant in the Association for the Development of Computer-based Instructional Systems (ADCIS). ADCIS is the principal national forum for the scholarly exchange of ideas regarding computer-based education, and the project regularly delivers progress reports at the association's annual meetings. Papers have also been presented at ADCIS special interest group meetings for health sciences, implementation, PLATO elementary-secondary schools, and music. The music interest group was founded by our University's Music Department by means of the PLATO Project. The Delaware PLATO Project is also fostering the development of special interest groups for art, reading, and human resources.

A big event in the history of the Delaware PLATO Project was hosting the 1977 ADCIS National Convention at the Hotel DuFont, February 20-24, 1977. Jointly funded by the Delaware School Auxiliary Association, the Wemyss Foundation, ADCIS, and the University of Delaware, the convention attracted the largest attendance in its ten-year history. The participation of 32 vendors made the exhibit area a most comprehensive showing of computer-based educational technology. A special feature was the pre-session held for teachers on Monday, February 21, in cooperation with the State Department of Public Instruction. Entitled "Introduction to Educational Computing" the pre-session was attended by more than 300 Delaware teachers. During the main portion of the convention, several presentations were made by members of the PLATO staff and of the faculty. These are published in the 1977 ADCIS Proceedings, and they are available upon request in the PLATO office.

At the 1978 ADCIS Convention which was held in Dallas, Texas from March 1 through March 4, 1978, all three members of the PLATO senior staff were elected officers. Bonnie Seiler was elected Newsletter Editor for the PLATO Users Group, Jim Wilson was elected System Representative in the PLATO Users Group, and Fred Hofstetter was re-elected to a third consecutive term as President of the National Consortium for Computer-Based Music Instruction and holds an ex officio seat on the ADCIS Steering Committee. Several members of the PLATO staff and of the faculty have made formal presentations at ADCIS conventions. These are listed in Table 5. Copies of the presentations are published in ADCIS Proceedings, available in the Delaware PLATO library.

Table 5

Presentations by Delaware Faculty and Staff
at National ADCIS Conventions

Name	Title of Presentation	Year
John Brown	"Mathematics Applications of Computer Technology"	1977
John Eisenberg	"Overview of the PLATO Modern Hebrew Prophet"	1977
Nevin Frantz	"A Computer Managed Instructional System for Vocational Technical Education"	1977
Fred T. Hofstetter	"GUIDO: An Interactive Computer-Based System for Drill and Practice in Ear-Training"	1976
Fred T. Hofstetter	"Interactive Simulation/Games as an Aid to Learning Music"	1977
Fred T. Hofstetter	"Computer-Based Recognition of Perceptual Patterns in Harmonic Dictation Exercises"	1978
Hank Hufnagel	"MENTOR - A PLATO-like system of CAI"	1977
Rosemary Killam	"Data Retention and Analysis: Experience and Recommendations"	1977
James Morrison	"Computing Applications in Business Education"	1977
Raymond Nichols and James H. Wilson	"The Computer Display as a Medium in the Teaching of Aesthetics in Visual Design"	1977
Bonnie A. Seiler	"Computer Assistance in the Social Processes of Learning"	1977
Richard Sharf	"A Computer-based Career Guidance System"	1977
James H. Wilson	"The Effects of Drill Structure on Learning in Phonetics Lessons"	1978
Rita Wagstaff	"Media Selection: Alternative Delivery Systems"	1978
Robert Uffelman	"Computer-Assisted Testing at the Education Resource Center"	1978

This chapter contains a summary of activities in the departments using PLATO at the University of Delaware. Sample lessons have been described with accompanying photographs in order to give the reader a general idea of the kinds of applications being pursued in the project. Study of these descriptions gives not only an overview of the wide range of activities which are being supported in the PLATO system, but it also provides a source of ideas from which new applications can arise.

-Accounting-

Faculty members in the Accounting Department will use PLATO for an estimated 17,000 hours in the Fall of 1978 to help teach Accounting I and Accounting II. Controlled evaluations will be run in order to determine whether the use of PLATO will improve student learning of the mechanics and theory of accounting and increase student interest and motivation. Examples of two accounting lessons are explained below.

Figure 6 shows how PLATO teaches students to make an income statement. An explanation and a sample income statement are followed by an exercise in which the student must move the accounts and balances given on the left side of the page over to the right side of the page. PLATO checks the student responses for the correct order, column, and balance.

Figure 7 demonstrates the usefulness of having PLATO teach the student how to make worksheets. First, each student makes adjustments to a given trial balance at the end of an accounting period. Then an adjusted trial balance is used to prepare an income statement and a balance sheet. Students using the worksheet lesson receive immediate feedback to their answers.

Prepare a multi-step income statement in proper form.
Press DATA for detailed instructions.
You may press HELP for a sample statement, but try to prepare the statement without looking at the sample.
Select your next action. (Press HELP if no display)
Column (1) (2)
INSERT ACCOUNTS AND BALANCES:
Sales $60000
Cost of Goods Sold
Beginning inventory $10000
Purchases 12000
Cost of Goods Avail $22000
Ending inventory 6000
Cost of Goods Sold 17000
Gross Margin $43000
Operating Expenses:
Advertising 3000
6 Delivery expense 2000
7 Rent expense 1500
8 Store salaries 9500
9 Office salaries 3000
10 Income tax expense 2500
11
12 Miscellaneous expense 500
13 Insurance expense 1000
14 Interest expense 1300
15 Store supplies used 2000
OTHER ACTIONS:
16 Enter total in column (1)
17 Enter total in column (2)
18 Statement completed!
19 Enter caption

Figure 6. Income Statement by James C. McKeown. Copyright © 1978 by the Board of Trustees of the University of Illinois.

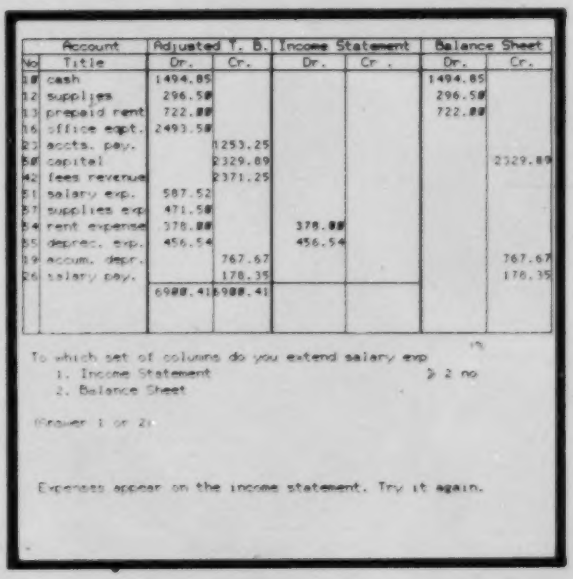
Account
No. Title
Adjusted T. B. Dr. Cr.
Income Statement Dr. Cr.
Balance Sheet Dr. Cr.
10 cash 1494.85 1494.85
12 supplies 296.50 296.50
13 prepaid rent 722.00 722.00
16 office eqpt. 2493.50
22 accts. pay. 1253.25
50 capital 2329.89 2329.89
42 fees revenue 2371.25
51 salary exp. 587.52
57 supplies exp 471.50
54 rent expense 378.00 378.00
55 deprec. exp. 456.54 456.54
59 accum. depr. 767.67 767.67
56 salary pay. 178.35 178.35
6900.41 6900.41
To which set of columns do you extend salary exp
1. Income Statement
2. Balance Sheet
(Answer 1 or 2)
» 2 no
Expenses appear on the income statement. Try it again.

Figure 7. Worksheets by James C. McKeown. Copyright © 1978 by the Board of Trustees of the University of Illinois.

Faculty members from the departments of Animal Science and Plant Science are using PLATO to provide students with simulated laboratory experiments and field experience which would be very costly to provide by other means. Most of the programs were originally developed by the College of Veterinary Medicine and by the Community College Biology Group at the University of Illinois. The successful implementation of these programs at the University of Delaware shows how through "courseware sharing" one institution can take advantage of PLATO programs written elsewhere.

In animal science, beginning students are using PLATO to study veterinary terminology, principles of digestion, muscular movement, mechanics of breathing, neuron structures and functions, spinal reflex loops, eye anatomy, and elementary psychophysiology of audition. Advanced undergraduates study mitotic cell division, probability and heredity, drosophilia genetics, natural selection, mitosis, gene mapping in diploid organisms, blood typing, population dynamics, pedigrees, karyotyping, and DNA, RNA, and protein synthesis. Graduate students concentrate on meiosis and the anatomy and physiology of reproduction.

In plant science, undergraduates run PLATO programs in cellular structure and function, water relations, diffusion, osmosis, genetics, and the spectrophotometer. Graduate students study plant pathology, enzyme experiments, respiration, biogeochemical cycles, enzyme hormone interactions, photosynthesis, seed germination, apical dominance, flowering and photoperiod, fruiting and leaf senescence, gas chromatography, and gene mapping in diploid organisms.

The kind of experience which agriculture students obtain from PLATO is illustrated in the following three examples. Figure 8 shows a sample display from the neuron structure and function program. PLATO simulates neurons with various internal structures. The student stimulates the neurons by pressing keys at the terminal, and observes the effects of the stimulations as read by a recording voltmeter. The student can experiment with different rates and patterns of stimulation. PLATO keeps track of what the student does and provides the student with reports in the form of response graphs.

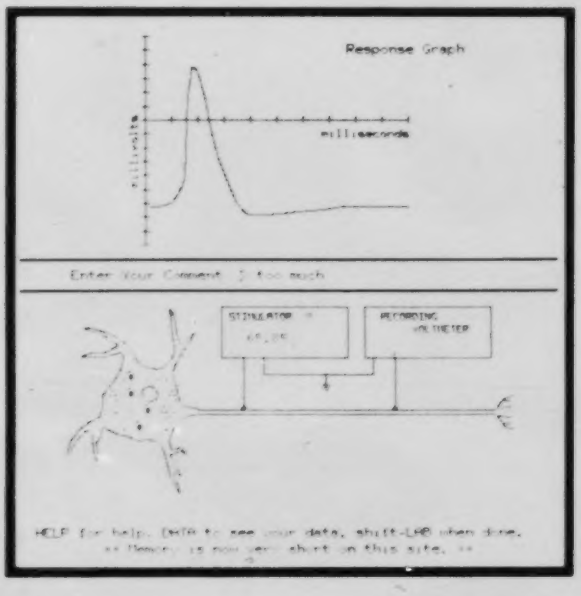

Figure 8. Neuron Structure and Function, by S. H. Boggs. Copyright © 1976 by the Board of Trustees of the University of Illinois.

Figure 9 shows the result of an apical dominance experiment. PLATO has given the student a plant with terminal and lateral buds intact. The student removes the apex, and is given a choice of replacing it with lanolin paste only or with lanolin paste plus one of five hormones. The student can experiment with choosing different hormones and observing their effects on the plant. In this case the student chose ethylene, and the plant branched.

Figure 10 shows how PLATO teaches the student how to run his own experiments. The student begins with the hypothesis that when two corn plants are crossed, the resulting generation will contain green plants and white plants in a ratio of 3:1. PLATO allows the student to cross two plants and observe the results, which in this case produced 100 green plants and 24 white plants. PLATO guides the student through a chi-square test of the hypothesis. When the student successfully completes the experiment, PLATO lets him go back and practice it again as often as he likes with an entirely new set of data each time.

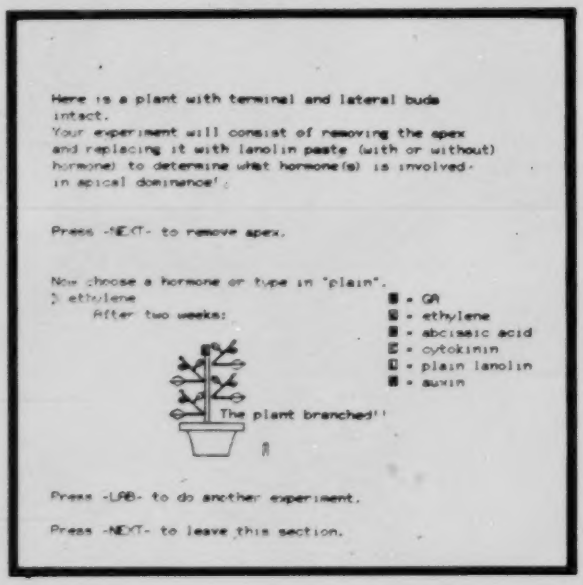
Here is a plant with terminal and lateral buds intact.
Your experiment will consist of removing the apex and replacing it with lanolin paste (with or without) hormone) to determine what hormone(s) is involved in apical dominance'.
Press -NEXT- to remove apex.
Now choose a hormone or type in "plain".
) ethylene
After two weeks:
= GA
= ethylene
= abcissic acid
= cytokinin
= plain lanolin
= auxin
The plant branched!
Press -LAB- to do another experiment.
Press -NEXT- to leave this section.

Figure 9. Plant Responses and Apical Dominance, by Mary Manteuffel and John Noell. Copyright (c) 1975 by the Board of Trustees of the University of Illinois.

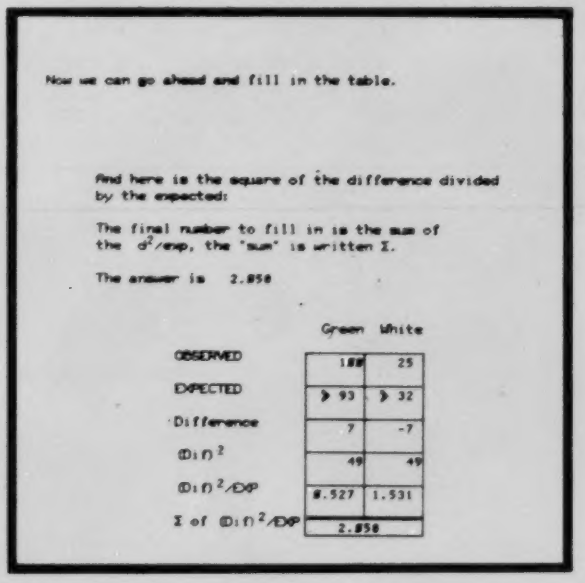
Now we can go ahead and fill in the table.
And here is the square of the difference divided by the expected:
The final number to fill in is the sum of the d²/exp, the "sum" is written Σ.
The answer is 2.858
Green White
OBSERVED 100 25
EXPECTED 93 32
Difference 7 -7
D1f²
D1f²/EXP 0.527 1.531
Σ of D1f²/EXP 2.858

Figure 10. Genetics: Pennett Square, Chi-Square, Medelian Ratios and Problems by John Noell, Gary N. May, Alan Harvey, and John Silvius. Copyright (c) 1976 by the Board of Trustees of the University of Illinois.

During the 1977-78 academic year, the College of Agriculture completed development of its first Delaware PLATO lesson. Dealing with the human endocrine system, the new Delaware lesson presents the student with an outline of the human body. PLATO then asks the student what endocrine structures he would like to see. Figure 11 shows how the student has asked to see the kidneys, and PLATO has responded by drawing the kidneys in the proper locations. Later on in the lesson, the body of the outine is drawn again with all of the structures drawn in their proper locations, and the student is required to correctly identify each structure.

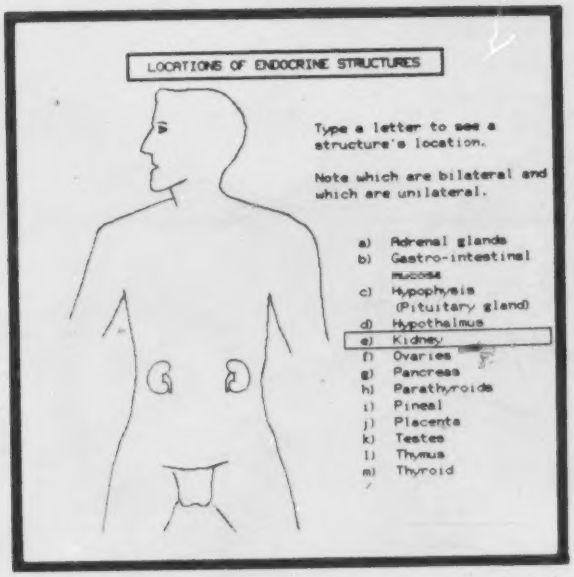

Figure 11. Endocrine System by Paul Sammelwitz and Dan Tripp. Copyright © 1978 by the University of Delaware PLATO Project.

-Anthropology-

The Anthropology Department is developing tutorials and drills to be used by students in its introductory courses. Lessons are currently being written for biological anthropology, and the department also plans to develp lessons for its archaeology and socio-cultural anthropology courses.

Biological anthropologists study cellular structure and genetic recombination from an evolutionary perspective. PLATO lessons about cellular structure and the genetic laws of inheritance, which emphasize this perspective, are being written to teach evolutionary theory. The figures below illustrate one section of a tutorial lesson on cellular structure. In Figure 12 a cellular part (in this case a mitochondrion) is being presented and described. In Figure 13 the student is being asked to identify a mitochondrion by touching the appropriate area on the touch-sensitive screen. The student will also have to answer questions about the function of each cellular part.

e) MITOCHONDRIA
Enzymes in a mitochondrion oxidize the cell's nutrients, forming carbon dioxide and water. This oxidizing metabolism also produces ATP, a chemical form of energy. For this reason, a mitochondrion can be called the cell's POWERHOUSE.
TWO MITOCHONDRIA
A MITOCHONDRION
Press the NEXT key to continue

Figure 12. Tutorial from Cellular Structure by Margaret Hamilton and Monica Berrang. Copyright © 1978 by the University of Delaware PLATO Project.

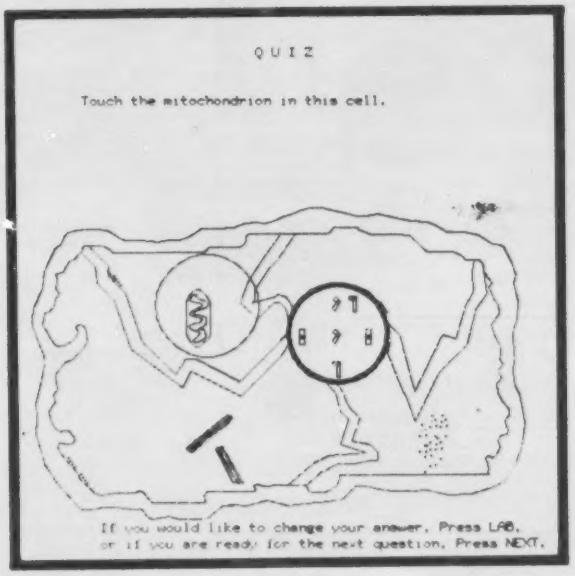
QUIZ
Touch the mitochondrion in this cell.
If you would like to change your answer, Press LAB.
or if you are ready for the next question, Press NEXT.

Figure 13. Quiz from Cellular Structure by Margaret Hamilton and Monica Berrang. Copyright © 1978 by the University of Delaware PLATO Project.

-Art-

The art department is developing its own package of PLATO programs for the purpose of improving instruction in basic design and graphic design, including courses in typography, basic illustration, advertising design, and portfolio preparation. Using the highly sophisticated graphics features of PLATO, students are interactively able to create and alter designs on the terminal screen. Work which used to take fifteen hours to complete on paper can be done in three hours on PLATO, thereby giving students the opportunity to work many more problems than they could before. They are also developing a better aesthetic judgment, because PLATO makes it so easy for them to alter their designs. If they don't like part of a design, PLATO lets them change that part while retaining the remainder of the design. Thus students are encouraged to make what they like rather than like what they make.

The main applications of PLATO in art can best be explained by looking at how students use three programs, namely, "unit design," "grey scale practice in tonal recognition," and "optical letter spacing." In the "unit design" program, the student enters a shape into the computer by either turning on or turning off dots on a 96 x 96 dot matrix. Figure 14 shows how the student creates the image by selecting options like "move," "delete point," "store," and "draw line." Next, the student uses the basic shape to form a composite image by performing graphic transformations of the basic shape. Figure 15 shows how the student creates the composite image by rotating, mirroring, and inverting the positive/negative relationships of each element.

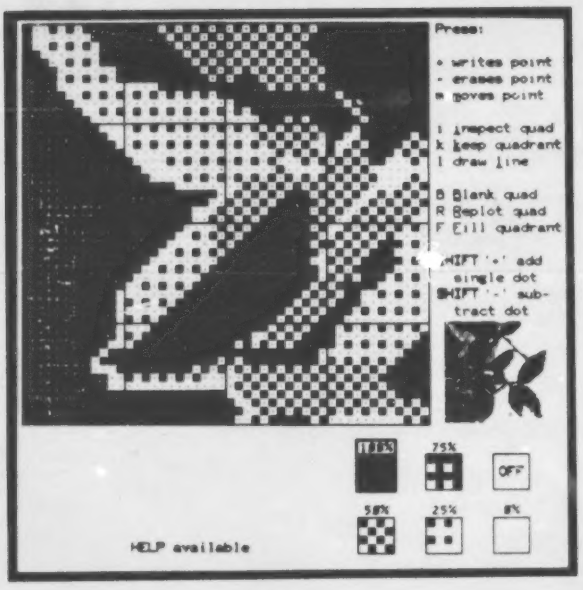

Figure 14. Unit Design by Ray Nichols; creating the basic image. Copyright © 1977 by the University of Delaware PLATO Project.

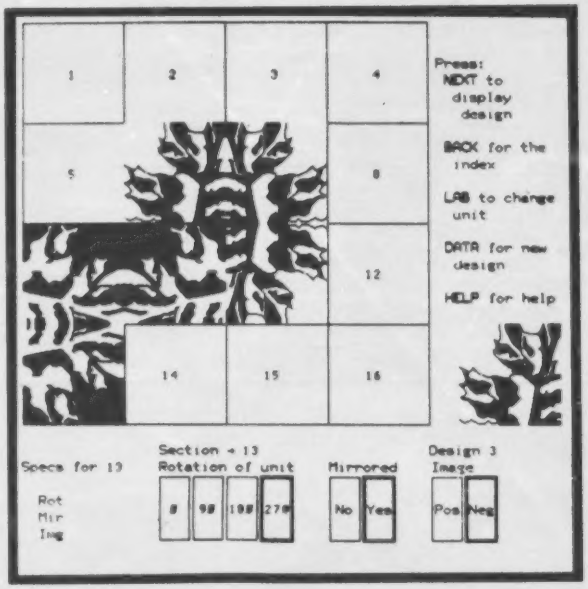

Figure 15. Unit Design by Ray Nichols; creating the composite. Copyright © 1977 by the University of Delaware PLATO Project.

Through successive tries at designing basic shapes and performing graphic transformations, the student learns how to create clever and intricate designs such as the one shown in Figure 16.

The grey scale program gives art students practice in recognizing the tonal values of the many shades of grey. PLATO presents the student with a grid of 20 x 30 squares. The student can then see the shade of grey for each square by telling PLATO the percentage of grey which should be in the square. Some students have become so adept at recognizing values of grey on PLATO that they can use the grey scale program to create facial images, such as the one shown in Figure 17.

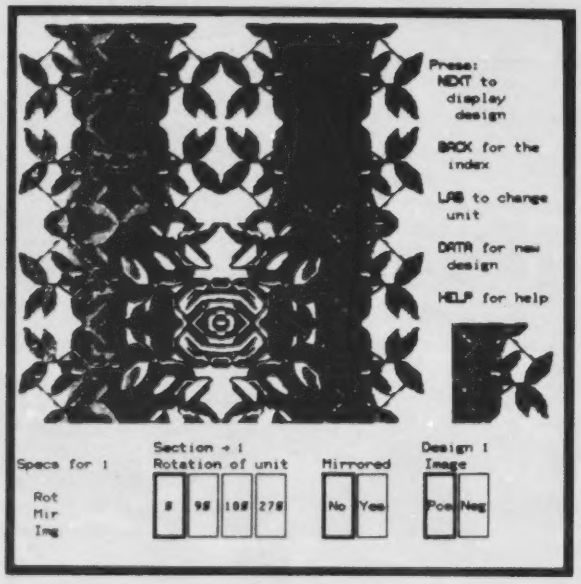

Figure 16. Unit Design by Ray Nichols; the finished product. Copyright © 1977 by the University of Delaware PLATO Project.

Figure 17. Grey Scale, by Ray Nichols Copyright © 1977 by the University of Delaware PLATO Project.

Since typography plays such an important role in advertising, it is extremely important for the art student to be able to space letters so that the printed word is both aesthetically pleasing and readable. The letter spacing program gives the students interactive practice in spacing letters without requiring them to go through the time-consuming process of drawing and inking a word every time they want to change the placement of a letter. Using PLATO, students can do many more assignments than were possible before, and the instructor is able to offer greater help to the students because he gets to see much more of their work. Students can work with words containing up to 9 letters from each of five typefaces: Helvetica, Baskerville, Garamond, Century Expanded, and Bodoni. Figure 18 shows a sample display from the letter spacing program. In this display the student is just about to move the "E" further over to the left.

The first two letters are fixed to correspond
to the comparison word's spacing.
This will allow us to have something in common
on which to base your spacing.
Pick the number of the letter you'd like to move:
Current letter being moved: 2
FINEST
1 2 3 4
Press:
'a' to move arrows to the left, 'd' to move arrow to the right
'+' for coarse positioning, '-' for fine positioning,
's' to display top arrows
NEXT to display the letter in its new position,
SHIFT-NEXT to move letters right of selected letter,
LAB to store the word in your list,
BACK to select a new word,
SHIFT-BACK to select another typeface.

Figure 18. Letter Spacing by Ray Nichols
Copyright © 1977 by the University of Delaware PLATO Project.

-Chemical Engineering-

The large number of students electing to major in engineering makes it difficult for some students to get necessary personal assistance in engineering problem-solving. The Chemical Engineering Department is exploring the use of PLATO to provide additional problem-solving experience.

The goals of the project include the development of PLATO lessons for several types of chemical engineering thermodynamics problems that have been especially troublesome to weaker students. The problems deal with ideal gases, adiabatic steam turbines, and real gas problems. In Figure 19 the student is asked to integrate the energy balance for the system selected. In this example, the student touched three boxes to select a variable (NU), a state (state 1), and a system (tire). Next, the student touched the second box in the equation at the top, which resulted in PLATO's writing "$N_1^t U_1^t$" in the second box. Once the student has completed the required equation, PLATO helps him learn to apply it. Other thermodynamics lessons are planned that will deal with important problem-solving concepts, such as the most effective use of the entropy balance and the reading of various thermodynamic properties charts.

In another lesson under development, the engineering student actively participates in the analysis and solution of simple mass balance problems. Figure 20 shows the diagram of a simple mixer which the student is to analyze in terms of mass balance. Using the material discussed in the lesson, he is asked specific questions that direct him toward an approach to solving the mixer.

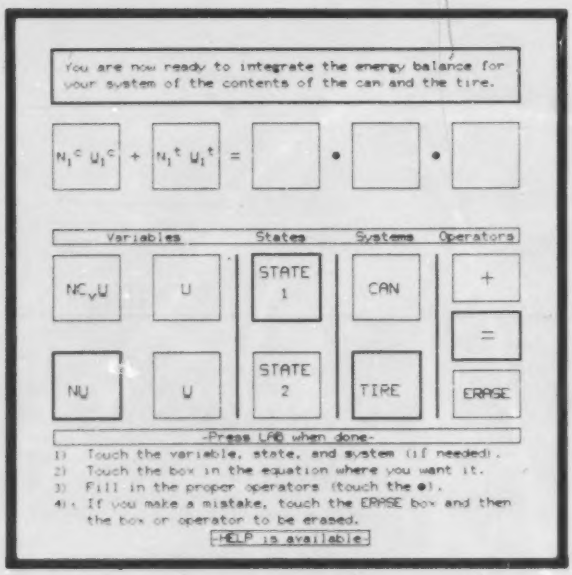
You are now ready to integrate the energy balance for your system of the contents of the can and the tire.
Variables
States
Systems
Operators
NC,U
U
STATE 1
CAN
+
=
NU
U
STATE 2
TIRE
ERASE
-Press LAB when done-
1) Touch the variable, state, and system (if needed).
2) Touch the box in the equation where you want it.
3) Fill in the proper operators (touch the ●).
4) If you make a mistake, touch the ERASE box and then the box or operator to be erased.
-HELP is available-

Figure 19. Expansion of An Ideal Gas by Stanley Sandler and Doug Harrell. Copyright © 1978 by the University of Delaware PLATO Project.

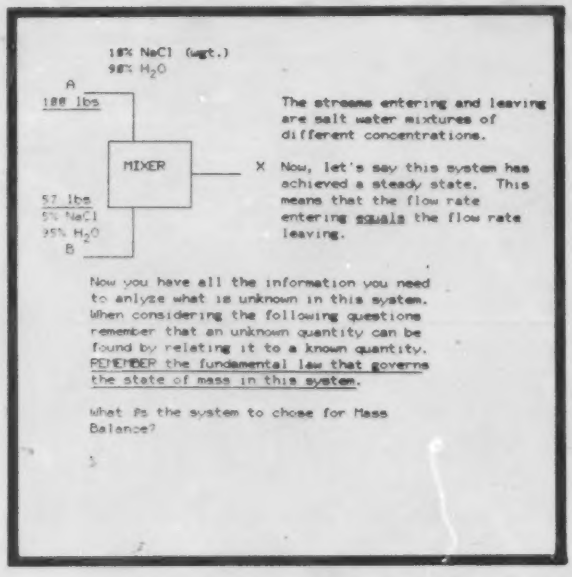
18% NaCl (wgt.)
98% H2O
A
188 lbs
MIXER
57 lbs
5% NaCl
95% H2O
B
X
The streams entering and leaving are salt water mixtures of different concentrations.
Now, let's say this system has achieved a steady state. This means that the flow rate entering equals the flow rate leaving.
Now you have all the information you need to anlyze what is unknown in this system. When considering the following questions remember that an unknown quantity can be found by relating it to a known quantity. REMEMBER the fundamental law that governs the state of mass in this system.
What is the system to chose for Mass Balance?

Figure 20. Introduction to Mass Balance by Robert Pigford and Brian Russell. Copyright © 1978 by the University of Delaware PLATO Project.

Taking advantage of the large package of chemistry lessons written under NSF funding at the University of Illinois, the chemistry department has enjoyed instant success in helping students learn to determine chemical formulas from the composition by weight, to calculate the percentage composition from the known chemical formula, to determine quantitative relations in chemical equations, to make rapid identification of unknowns, and to perform multiple step organic syntheses for electrophilic aromatic substitution reactions. By using the computer to simulate chemical reactions, students get to work with many more samples than is possible in the traditional chemistry lab. PLATO gives the student the freedom to experiment with many methods of solving a given problem.

Figure 21 shows how experience in rapid identification of unknown organic compounds is provided by a lesson in which the student simply asks questions about the compound. The computer provides instantaneous answers, such as giving the boiling point or showing the NMR spectrum of the unknown compound. The vocabulary of the program is adequate to answer all of the experimentally useful questions about the compound under investigation. Figure 22 shows how PLATO teaches the standardization of an aqueous NaOH solution by simulating acid-base titrations. The student must perform every step in the simulation from filling the buret to observing the change of color at the end of the experiment. PLATO makes sure that the student follows correct laboratory procedures, helping out with suggestions when necessary.

Type your question about the unknown and then press NEXT.
When you have identified the compound press BACK.
> What is the boiling point?
The boiling point is 245 to 247° at 1 atm.
SCORE = 1
For tables of data press DATA. To review press LAB.
For help press HELP.

Figure 21. Qualitative Organic Analysis, by Stanley Smith. Copyright © 1972 by the Board of Trustees of the University of Illinois.

ACID-BASE TITRATIONS
Standardization of an aqueous NaOH solution.
In this experiment you are to determine the concentration of a NaOH solution by titration of potassium acid phthalate (MW = 204).
The base is about 0.1 M.
What do you want to do first?
> fill the buret
Plato is filling the buret for you.
Press s to stop filling
Press f to restart filling.
Fill the buret almost to the top.
For help press HELP. To use a calculator press DATA

Figure 22. Acid-Base Titrations, by Stanley Smith. Copyright © 1976 by the Board of Trustees of the University of Illinois.

The faculty is investigating the value of PLATO as a tool in teaching topics in civil engineering. A lesson is being designed for use in the statics course, covering the topics of shear and moment. Figure 23 shows a drill in which the student must calculate the shear at various points along a beam being acted on by point forces. If the student answers correctly, he continues on to another problem. If not, the student is given a hint, depending on the nature of his error, and then he must try again. Available to students are a calculator to perform mathematical calculations, and a help section in case the student encounters difficulty on a problem.

Figure 24 is from a part of the lesson dealing with distributed forces. PLATO has explained a procedure for finding the resultant of a combination of distributed forces. The student is asked to use this procedure to solve a problem. Here again the student is provided with a calculator and with help sequences as needed.

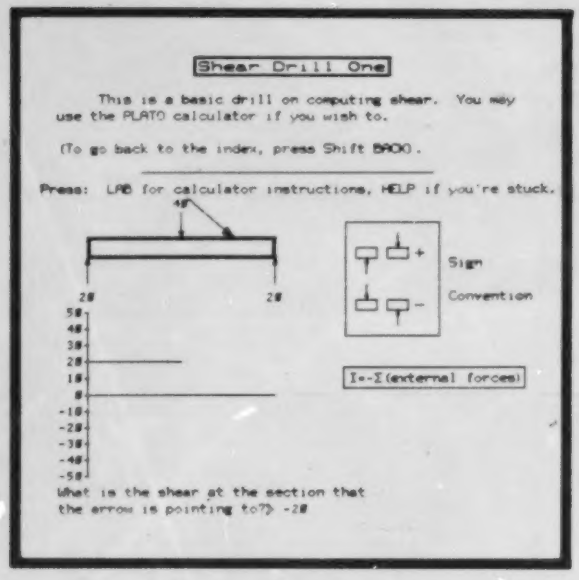
Shear Drill One
This is a basic drill on computing shear. You may use the PLATO calculator if you wish to.
(To go back to the index, press Shift BACK).
Press: LAB for calculator instructions, HELP if you're stuck.
4#
2#
2#
Sign
Convention
I=-I(external forces)
What is the shear at the section that the arrow is pointing to?> -2#

Figure 23. Drill on Shear and Moment by Eugene Chesson and Jeff Snyder. Copyright © 1978 by the University of Delaware PLATO Project.

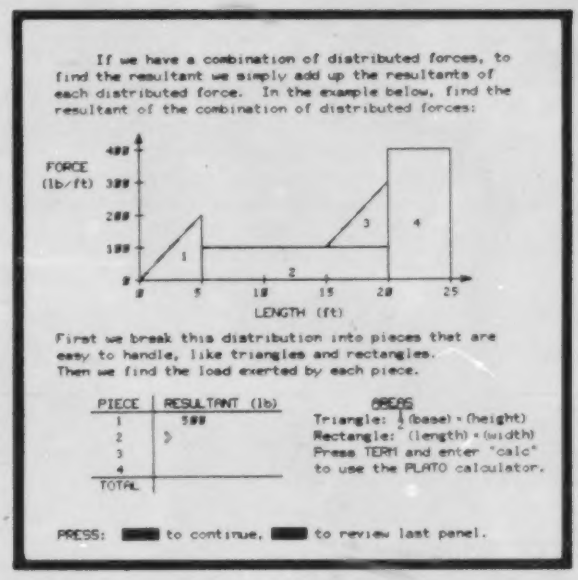
If we have a combination of distributed forces, to find the resultant we simply add up the resultants of each distributed force. In the example below, find the resultant of the combination of distributed forces:
FORCE (lb/ft)
LENGTH (ft)
First we break this distribution into pieces that are easy to handle, like triangles and rectangles. Then we find the load exerted by each piece.
PIECE
RESULTANT (lb)
TOTAL
AREAS
Triangle: ½ (base) * (height)
Rectangle: (length) * (width)
Press TERM and enter "calc" to use the PLATO calculator.
PRESS: to continue, to review last panel.

Figure 24. Tutorial on Shear and Moment by Eugene Chesson and Jeff Snyder. Copyright © 1978 by the University of Delaware PLATO Project.

A general need of the communication major is skill in the use of at least one system of phonetic transcription. The most effective method of practice for the development of this skill is one involving transcription from oral dictation. Immediate feedback on accuracy significantly increases the rate of development. The Communication Department has found PLATO to be a good medium for providing this kind of practice. PLATO's random-access audio device is used to give the oral dictation. The use of PLATO to present dictation and judge student responses not only decreases the amount of class time that must be devoted to this activity for all students, but is also offers an opportunity for those who need more practice time to get it without doing so at the expense of the students who do not.

Figures 25 and 26 show some of the strategies used in PLATO's phonetics programs. Figure 25 shows a talking robot program which students use to experiment with the physiology of phonetic production. This program allows the student to move the tongue, velum, and lips in various positions, and at any time the student can find out what sound would be produced. The computer shows the student not only the side view of the robot's head, but also the palatogram. Figure 26 illustrates another strategy in which PLATO gives the description of a consonant and them asks the student to type the corresponding consonant.

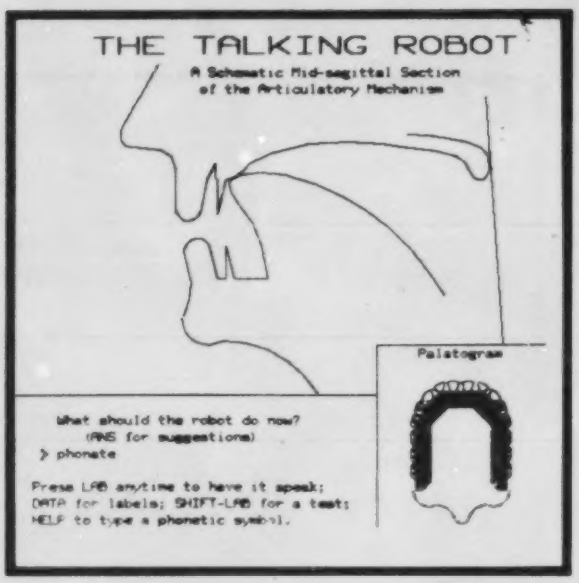
THE TALKING ROBOT
A Schematic Mid-sagittal Section of the Articulatory Mechanism
Palatogram
What should the robot do now?
(ANS for suggestions)
> phonate
Press LAB anytime to have it speak;
DATA for labels; SHIFT-LAB for a test;
HELP to type a phonetic symbol.

Figure 25. The Talking Robot: A Simulation of Speech Sound Production, by James H. Wilson and Elaine P. Paden. Copyright ©1975 by the Board of Trustees of the University of Illinois.

CONSONANTS: FEATURES-SYMBOLS
fortis alveolar fricative
> z no
The consonant you specified has the following features:
lenis alveolar fricative
Type the consonant, then press NEXT.
Press ANS to give up on one.
Press HELP to see the phonetics keyset.
Press BACK to choose another type of drill.

Figure 26. Organogenetic Feature Drills, by James H. Wilson and Elaine P. Paden. Copyright ©1975 by the Board of Trustees of the University of Illinois.

The Computer Science Department is developing a computer literacy package for the humanities on the PLATO system. This package will include lessons on the SNOBOL and BASIC programming languages, SNOBOL and BASIC compilers, instruction on the use of a text-editing system, and a lesson on the development and the practice of applications of computers in the humanities. This will be a first step in the department's goal of providing courseware on computer literacy for disciplines on the campus. The text editor will make full use of not only the line-oriented text-editing facilities already in the PLATO system, but also of cursor-editing techniques.

Existing lessons on the PLATO system range from advanced topics such as systems programming, numerical analysis, and information processing, to introductory lessons that teach what a computer is, basic computer terminology, and programming languages. Shown below are two lessons that teach FORTRAN programming. In Figure 27, the students are given an "old program," and they are asked to retype it as a "new program" by compressing the if-statements together using Boolean constructs. So far, the student has written the third and fourth lines of the old program as one statement in the third line of the new program, and he is in the process of making the fifth, sixth, and seventh lines of the old program the fourth line of the new program. Figure 28 shows how PLATO can simulate a FORTRAN compiler and help the students understand what the various statements do by allowing them to change their parameters and then observe their execution. In this example, the students are allowed to use four formating statements and two program execution statements. The students can edit the statements, enter data cards, initialize variables, and execute the program to find out the effects of their changes.

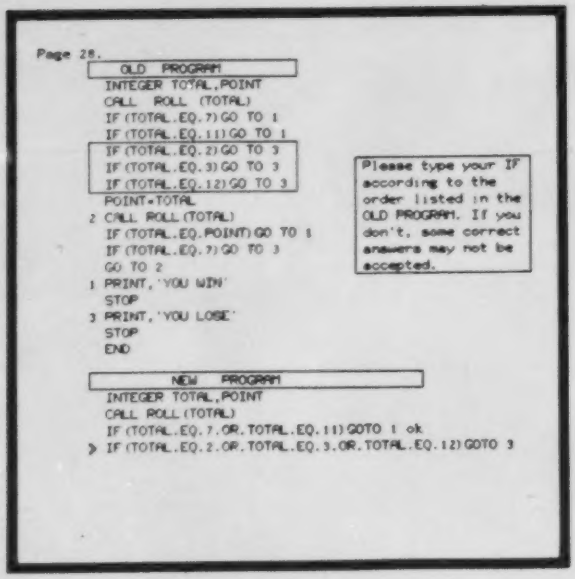

Figure 27. Experience with FORTRAN FORMAT Statements by Rick Simkin and H. G. Friedman. Copyright © 1977 by the Board of Trustees of the University of Illinois.

6.99 43.8
READ I, A, B
PRINT 3, J
What do you want to do? 1,2) Last READ or PRINT statement >
3) Enter a statement 4) Enter data cards 5) Start new variables
1 FORMAT(F10.4,F4.2)
2 FORMAT(I10,I5)
3 FORMAT('0',' THIS IS AN INTEGER ',I10)
4 FORMAT('0',' THIS IS A REAL ',F12.4)
A = 6.99 J = -14
B = 43.8
I = 7
THIS IS AN INTEGER -14

Figure 28. Understanding the FORTRAN IF Statement by Greg Strass. Copyright © 1975 by the Board of Trustees of the University of Illinois.

The Center for Counseling is using PLATO to develop a computer-based career guidance system which allows people to clarify their interests and abilities and helps them explore the characteristics of occupations. The Division of Continuing Education is providing funds to use the system in its adult counseling operations. The system consists of two parts. The first part consists of a computerized version of The Self Directed Search, an interest and ability inventory developed by John Holland (1974). The user spends fifteen to twenty minutes answering 228 items in the six scales of the inventory, namely, realistic, investigative, artistic, social, enterprising, and conventional. Figure 29 shows a sample display from the investigative scale. In this scale, the user indicates whether the activities printed on the screen are liked or disliked by touching the appropriate boxes. The boxes chosen by the user light up.

When the user completes The Self Directed Search, PLATO computes the scores for each of the six inventories. After comparing these scores to a data bank of occupations, PLATO then allows the user to ask questions regarding the occupations. In figure 30 PLATO has been asked to display the employment outlook for the occupation "guidance counselor." The computer memory contains current information on 317 occupations. PLATO allows the user to look at any occupations he wishes to examine, in an order determined by PLATO.

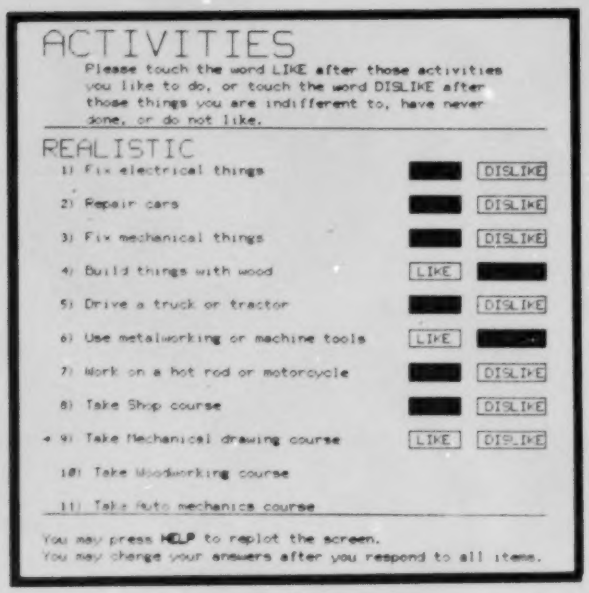
ACTIVITIES
Please touch the word LIKE after those activities you like to do, or touch the word DISLIKE after those things you are indifferent to, have never done, or do not like.
REALISTIC
1) Fix electrical things
2) Repair cars
3) Fix mechanical things
4) Build things with wood
5) Drive a truck or tractor
6) Use metalworking or machine tools
7) Work on a hot rod or motorcycle
8) Take Shop course
9) Take Mechanical drawing course
10) Take Woodworking course
11) Take Auto mechanics course
LIKE
DISLIKE
You may press HELP to replot the screen.
You may change your answers after you respond to all items.

Figure 29. Interest Inventory from The Self Directed Search, by John L. Holland. Copyright © 1977 by Consulting Psychologist Press, Inc.

Guidance Counselor
S -social
E -enterprising
A -artistic
Type in the number of the section that you would like to see.
Sections to see:
1) Description
2) Education
3) Qualifications
4) Salary
5) Work Conditions
6) Employment Outlook
7) For More Information
Slower employment growth due to a decline in school enrollments. The extent of future growth will depend largely on the amount of funds which the Federal Government provides.
You may see more than one section if you wish.
Press NEXT to see the next occupation that PLATO has for you.
Press LAB to stop looking at these occupations.
press HELP for assistance.

Figure 30. Occupational Search, by Dr. Richard Sharf. Copyright © 1977 by the University of Delaware PLATO Project.

This project differs from other computerized guidance projects in several ways. It begins with an assessment of the individual's interest and abilities using a well-validated inventory, rather than an exploration of a large data base of job information without any direction. Its data base includes occupations for college students and adults returning for further education. Access to the system has been made as simple as possible so that people who have never used a computer terminal can benefit from the system. PLATO is being used not only for the delivery of career guidance, but also for the creation of a data base of information on how people make career choices.

During the summer months, the Counseling Department has given prospective new students the opportunity to explore occupations in the department's new PLATO package "Job Aids." "Job Aids," shown in Figure 31, allows users to type the title of any occupation they want information about. PLATO interprets what they have written and provides information about the occupation or about one like it. The seven categories of information available on each occupation are shown in Figure 32. If the occupational title that the user enters is too broad or vague, such as "engineer," the user is referred to an appropriate index of occupations, such as "careers in engineering."

Student response data about occupational information seeking is being generated and stored from this part of the career counseling package. Comparisons will be made between information seeking styles used in "Job Aids" and those used in "Career Search."

The Occupation Arrow
Type in the occupation or area that you would like to know some information about.
Then press NEXT.
Press the ERASE key to correct typing errors. This key will erase one letter or space at a time.
Press HELP to read the introduction again.
Press SHIFT-BACK to leave.

Figure 31. The Occupation Arrow from Job Aids, by Richard Sharf and Mark Laubach. Copyright (c) 1978 by the University of Delaware PLATO Project.

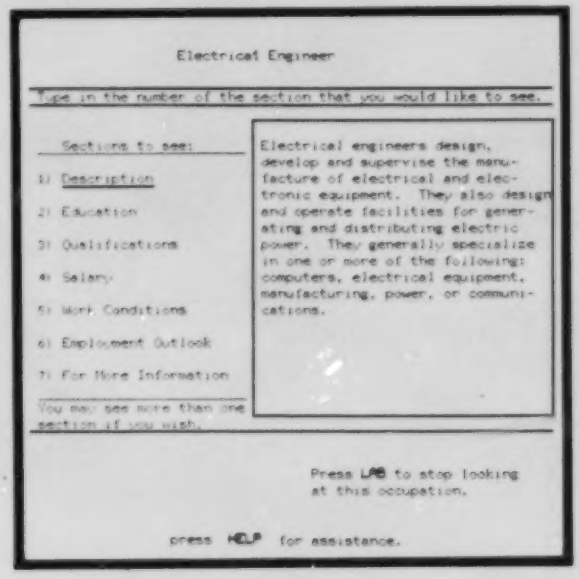
Electrical Engineer
Type in the number of the section that you would like to see.
Sections to see:
1) Description
2) Education
3) Qualifications
4) Salary
5) Work Conditions
6) Employment Outlook
7) For More Information
You may see more than one section if you wish.
Electrical engineers design, develop and supervise the manufacture of electrical and electronic equipment. They also design and operate facilities for generating and distributing electric power. They generally specialize in one or more of the following: computers, electrical equipment, manufacturing, power, or communications.
Press LAB to stop looking at this occupation.
press HELP for assistance.

Figure 32. Sample Discription from Job Aids, by Richard Sharf and Mark Laubach. Copyright (c) 1978 by the University of Delaware PLATO Project.

Students in macroeconomics are using PLATO to learn the principles and the practice of economic modeling by means of computerized simulations. Students can change economic variables such as income employment and price level, and they can observe the effects of these changes in graphs drawn on the display screen. The students can repeat individual lessons as often as they like, and they can move on to more difficult exercises whenever they are ready. The economics package includes quizzes at the end of each lesson to insure that the students have mastered the concepts presented in the simulations. It also gives periodic hourly examinations throughout the semester.

Reading about how autonomous consumption, induced consumption, autonomous investment, induced investment, government spending and the tax rate affect the economy can be very confusing for the beginning student. PLATO presents these concepts in an individualized, self-paced format, making sure that the student understand them before moving on to more difficult material. Figure 33 shows how PLATO uses graphs to teach the ways in which individual firms can influence prices. Firms operating under monopoly, oligopoly, and monopolistic competition are presented. PLATO asks questions which both insure that the student is reading the graphs correctly and also understanding the basic concepts associated with each graph. Figure 34 shows how a display can be dynamically created while the students is working through a lesson. To make sure that the student understands the interaction of the cost curves, PLATO asks the student questions as the curves are drawn. When the student answers correctly, more of the curves are drawn.

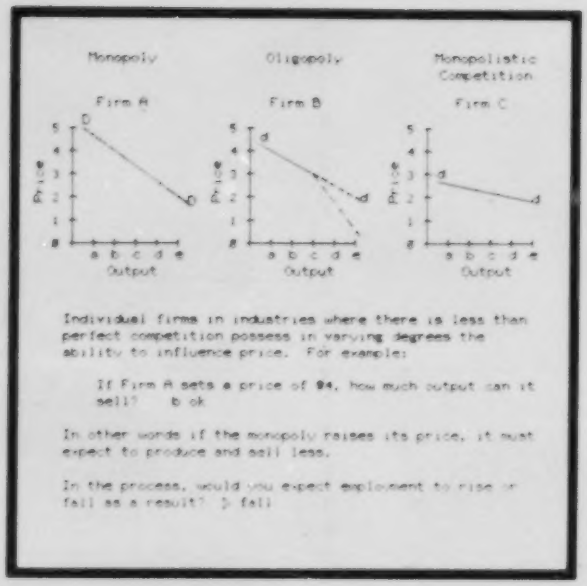
Monopoly
Oligopoly
Monopolistic Competition
Firm A
Firm B
Firm C
Output
Individual firms in industries where there is less than perfect competition possess in varying degrees the ability to influence price. For example:
If Firm A sets a price of $4, how much output can it sell? b ok
In other words if the monopoly raises its price, it must expect to produce and sell less.
In the process, would you expect employment to rise or fall as a result? b fall

Figure 33. Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr. Copyright © 1975 by the Board of Trustees of the University of Illinois.

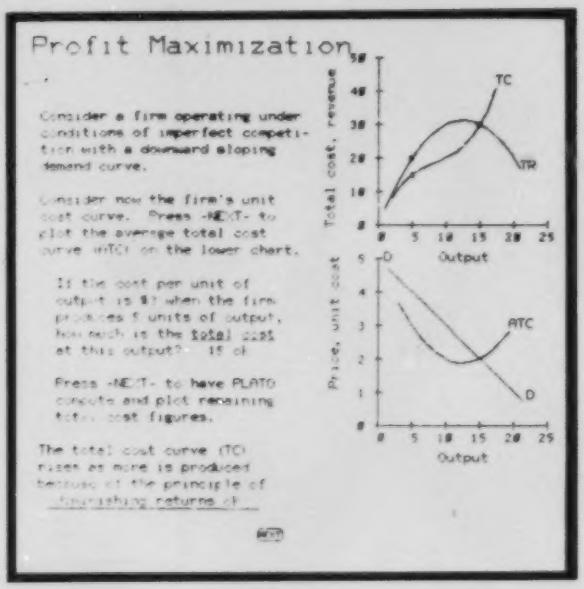
Profit Maximization
Consider a firm operating under conditions of imperfect competition with a downward sloping demand curve.
Consider now the firm's unit cost curve. Press -NEXT- to plot the average total cost curve (ATC) on the lower chart.
If the cost per unit of output is $1 when the firm produces 5 units of output, how much is the total cost at this output? If ok
Press -NEXT- to have PLATO compute and plot remaining total cost figures.
The total cost curve (TC) rises as more is produced because of the principle of diminishing returns ok
Total cost, revenue
TC
TR
Output
Price, unit cost
ATC
D
Output

Figure 34. Imperfect Competition, by Donald W. Paden, James Wilson, and Michael D. Barr. Copyright © 1975 by the Board of Trustees of the University of Illinois.

The College of Education uses PLATO to give its students college-level instruction in educational psychology, statistics, and analysis of reading retardations. Four instructional lessons were written by College of Education faculty this year. First, "Factors in Reading Comprehension" was developed by Dr. Frank Murray for the University's psychological foundation course which, like many other behavioral science courses, often has students replicate appropriate psychological laboratory experiments. This year, one of these laboratory exercises was successfully placed on PLATO, enabling a more sophisticated experiment to be carried out by the students. The exercise, "Factors in Reading Comprehension," was a study of the effects of familiarity with terminology upon reading comprehension. PLATO presented the students with the opportunity to become familiar with certain nonsense words such as "tarup" and "gokem" before these words were embedded, along with other nonsense words, in a prose passage typical of grade school instructional exercises. Figure 35 shows a sample display from a story about an inventor who made a machine to play baseball with his children. All of the machine's parts are named with nonsense words used in the story. PLATO facilitated a high degree of experimental control by presenting each student with a different passage randomized on certain critical dimensions. In addition to participating in an improved laboratory experience, the students also learned about some of the instructional potential of the PLATO system. As a further bonus, the data from the exercise had some scientific merit since the improved design allowed a firmer demonstration of the instructional utility of familiarization effects.

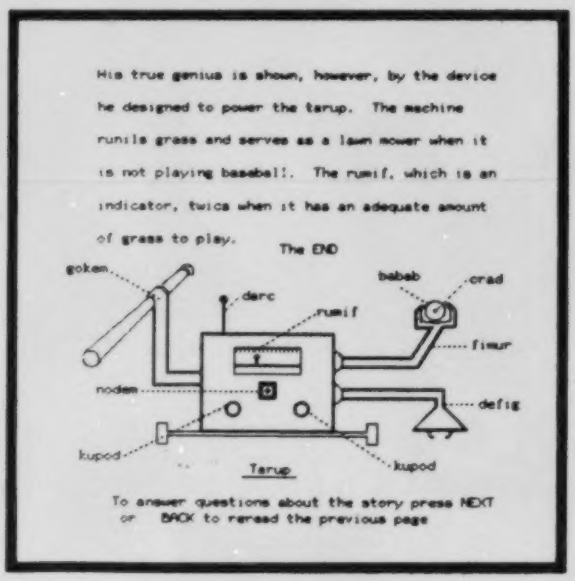
His true genius is shown, however, by the device he designed to power the tarup. The machine runils grass and serves as a lawn mower when it is not playing baseball. The rumif, which is an indicator, twics when it has an adequate amount of grass to play.
The END
goken
darc
rumif
babab
crad
fimur
nodem
defig
kupod
kupod
Tarup
To answer questions about the story press NEXT or BACK to reread the previous page

Figure 35. Factors in Reading Comprehension by Jack Murray and Judy Sandler. Copyright (c) 1978 by University of Delaware PLATO Project.

Second, "The Effect of Sampling Variability and Range Restriction of Pearson's Coefficient of Correlation" was developed by Dr. Victor Martuza to introduce education students to the causes and typical effects of sampling variability. After giving some preliminary instruction on the subject, the lesson presents the students with a population of two-dimensional data points and their summary statistics. By choosing the sizes of random samples and restricting the range from which such samples are taken, the students are able to build a collection of samples of various sizes and ranges. For each sample PLATO calculates the means, standard deviations, covariance, and correlation, and the students are able to judge for themselves the reliability of estimates of population characteristics based on their samples. Figure 36 shows how a student chose a small sample size of five data points which produced misleading results.

Third, "FASTER - Fast Accurate Symbol Transcription for Evaluation of Elementary Reading" was designed by Dr. John Pikulski to increase the speed and accuracy with which graduate level reading clinicians record children's responses on an Informal Reading Inventory and a Word Recognition Test. Figure 37 shows how each response is presented in a box at the top of the screen. The clinician must touch the symbol that is used to transcribe the response. PLATO keeps a record of how well each clinician does and ranks them in order of speed in a "Hall of Fame" list.

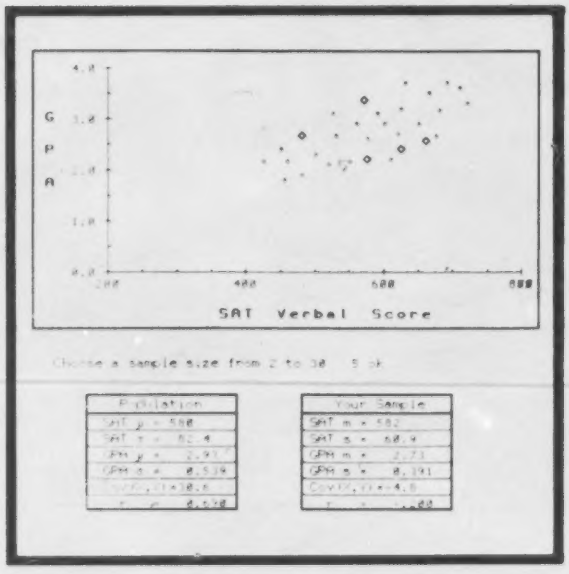

Figure 36. The Effects of Sampling Variability and Range Restriction on Pearson's Coefficient of Correlation, by Victor Martuza and James Trueblood. Copyright (c) 1978 by the University of Delaware PLATO Project.

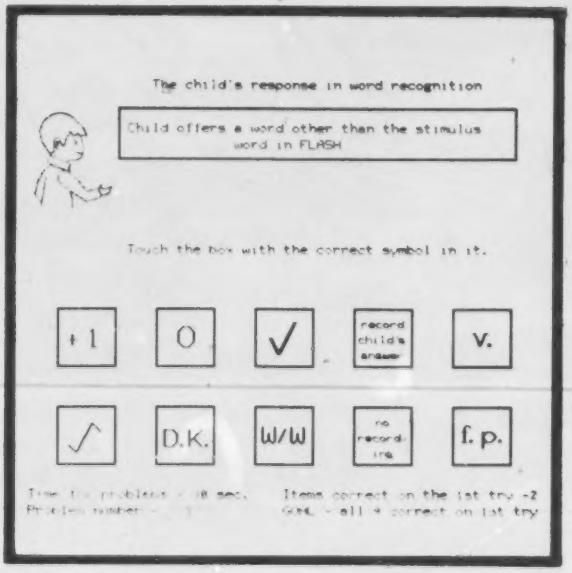

Figure 37. Fast Accurate Symbol Transcription for Evaluation of Elementary Reading by John Pikulski and Deborah Braendle. Copyright (c) 1978 by the University of Delaware PLATO Project.

Fourth, the Reading Study Center is developing a package of remedial reading lessons designed to teach both "survival" words (words that an adult needs to be able to recognize in order to get through daily life, such as "telephone" and "stop") and words from the Dolch sight word list. The lessons follow a theme involving spies and secret passwords. The basic instructional lesson is called "SWAT" (Sight Word Attack Team). Lesson "SWAT" teaches words in groups of four. Major activities in the lesson include:

1) watching an animated "briefing" on the word--an amusing illustrated story containing the password in each sentence. Figure 38 shows a story on the word "stop" in which a car has stopped too late and has crashed into a bicycle that gets away undamaged.

2) selecting a password from among four foils to complete a "secret message." In Figure 39 the student is asked to touch the word "telephone."

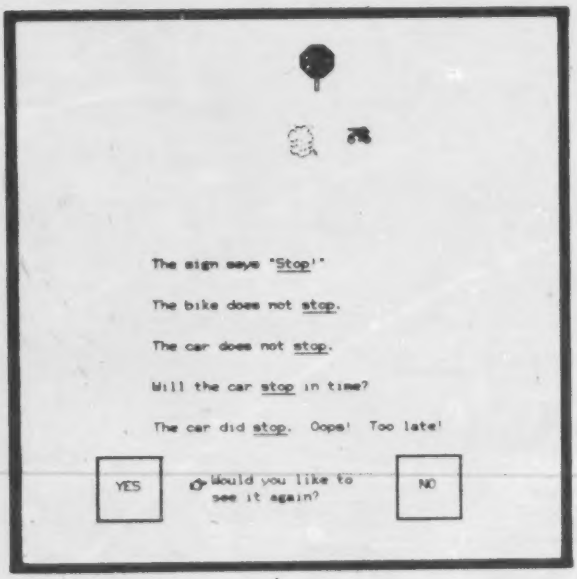
The sign says "Stop!"
The bike does not stop.
The car does not stop.
Will the car stop in time?
The car did stop. Oops! Too late!
YES
Would you like to see it again?
NO

Figure 38. Animated Story from SWAT (Sight Word Attack Team) by Rosalie Bianco, Peter Pelosi, and Jessica Weissman. Copyright (c) 1978 by the University of Delaware PLATO Project.

Figure 39. Touch the Password from SWAT (Sight Word Attack Team) by Rosalie Bianco, Peter Pelosi, and Jessica Weissman. Copyright (c) 1978 by the University of Delaware PLATO Project.

3) decoding a message through spelling the password by touching letters on the decoder machine. In Figure 40 the student is spelling the word "stop."

4) finding the password in a scramble of words. Figure 41 shows how the screen looks after the student touches four occurrences of the word "stop."

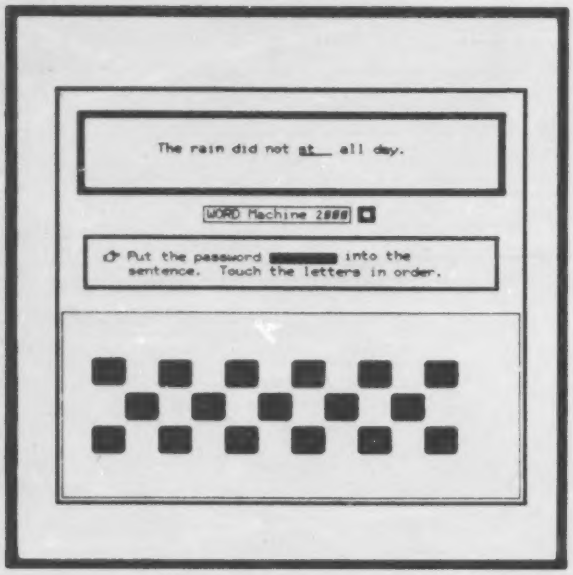

Figure 40. Spell the Password from SWAT (Sight Word Attack Team) by Rosalie Bianco, Peter Pelosi, and Jessica Weissman. Copyright (c) 1978 by the University of Delaware PLATO Project.

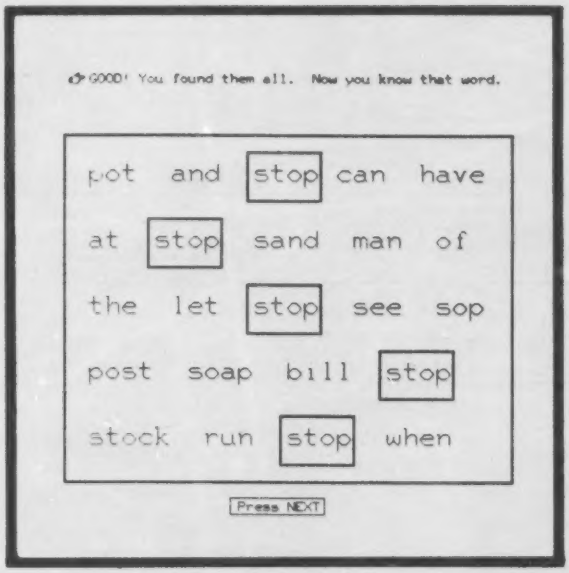
GOOD! You found them all. Now you know that word.
pot and stop can have
at stop sand man of
the let stop see sop
post soap bill stop
stock run stop when
Press NEXT

Figure 41. Finding the Passwords in SWAT (Sight Word Attack Team) by Rosalie Bianco, Peter Pelosi and Jessica Weissman. Copyright (c) 1978 by the University of Delaware PLATO Project.

5) telling real spies from fake ones by deciding whether the sentence the spy is saying contains the password. In Figure 42 the student is being asked whether the spy is saying the password "bank."

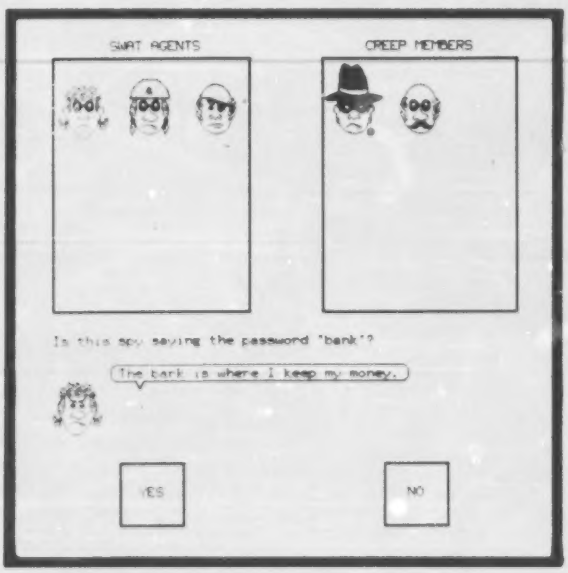

Figure 42. Identifying the Spy in SWAT (Sight Word Attack Team), by Rosalie Bianco, Peter Pelosi and Jessica Weissman. Copyright (c) 1978 by the University of Delaware PLATO Project.

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The reading center is also developing instructional games in which the student practices distinguishing the target words from each other. In "Make a Spy," for example, the student's reward for "guessing" the secret message is the chance to select part of a spy disguise for himself. The students like to fix sentence after sentence just for the opportunity to make their own funny spy faces. Like all other reading materials developed on PLATO, the SWAT package uses random access audio to deliver instructions and feedback to the student. However, where previously written lessons automatically initiate the delivery of audio, the SWAT lessons use a different strategy known as learner-controlled audio. With learner-controlled audio, all of the directions and feedback are written on the screen. The student initiates the message by touching the screen when he is ready to listen. After the student has heard a message once, he is able to touch the message in order to hear it again.

There are three advantages of learner-controlled audio over more conventional programming techniques. First, students are never surprised by messages which they are not ready to hear. Second, students can hear any message again if they need help. Third, since the messages are written on the screen, the student sees them many times and becomes familiar with them. Eventually, the student learns how to read the messages by himself.

-English-

The English Department has found PLATO to be a valuable tool for improving writing skills, especially for those students taking the three credit, pre-E110 course taught by the Writing Center staff which used feedback from PLATO to individualize student programs both on the computers and in the small groups of four students per instructor taught at the Writing Center. Designed and put on PLATO by community college English teachers in Illinois, the lessons cover punctuation, sentence structure, spelling, paragraph structure, verbs, and verb form. THey also include diagnostic programs which gather information on individual students' skills in several areas of usage and punctuation.

Figure 43 shows a simple drill in which the student is asked to identify parts of speech in a sentence. In this example the student was first asked to identify the pronoun in the sentence; the student correctly answered "their." The student was then asked to iedntify that pronoun's antecedent; the student correctly answered "children," and was appropriately congratulated. A special feature of this lesson is the interactive help which students receive when they answer incorrectly. In this example if the student had answered "are" instead of "their," PLATO would have told him that "are" is a verb, not a pronoun.

Figure 44 shows a more complex exercise in which the student is given a paragraph which contains misused words. The student is asked to identify and correct the misused words. When a misused word has been corrected, PLATO crosses it out and prints the correct word above it. In the example given the student has already corrected the words "they're" and "which" and "Irregardless," and is now changing "hisself" into "himself."

Figure 43. Pronoun Agreement, by Delores Lipscomb. Copyright © 1976 by the University of Illinois at Chicago Circle.

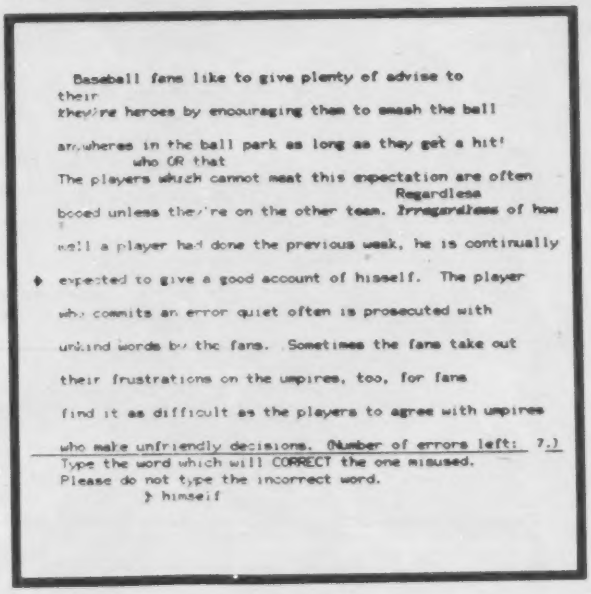

Baseball fans like to give plenty of advise to
their
they're heroes by encouraging them to smash the ball
anywheres in the ball park as long as they get a hit!
who OR that
The players which cannot meat this expectation are often
Regardless
booed unless they're on the other team. Irregardless of how
well a player had done the previous week, he is continually
expected to give a good account of hisself. The player
who commits an error quiet often is prosecuted with
unkind words by the fans. Sometimes the fans take out
their frustrations on the umpires, too, for fans
find it as difficult as the players to agree with umpires
who make unfriendly decisions. (Number of errors left: 7.)
Type the word which will CORRECT the one misused.
Please do not type the incorrect word.
} himself

Figure 44. Paragraph Editing: Word Usage, by Errol M. Magidson and Mitsuru Yamada. Copyright © 1974 by the City College of Chicago.

-Honors-

PLATO became part of the Freshman Honors Program in Dover during the Spring Semester of 1978. With four terminals installed on the Wesley campus, it became a very popular aspect of the program. Use among the students and staff took several forms. In addition to using PLATO in their classes, some of the students were interested in programming their own lessons. Fifteen honors students became lesson authors. They learned to do drawings, compose music, and make animations. One of the students wrote a game called Dive Bomber. The player is the commander of a ship which is being attacked by a dive bomber. The player is asked to give an estimate in meters of how far away the plane is. The object of the game is to shoot down the plane before it destroys the player's ship. Each time the player misses he is told how far he overshot or undershot, and from that information he can calculate the proper distance for the next shot.

Several honors faculty became PLATO authors and designed lessons to be used by their students. One lesson designed for class plots a vector field V = M(x,y)i + N(x,y)j. The student is asked to give functions M and N. Any valid expressions in x and y may be used. Figure 45 shows how PLATO plots the corresponding vector field. Another faculty lesson was written in a game format to teach polar coordinates. In this game the student must aim the cannon of a tank at a target and fire the proper distance to score a hit. The student aims the tank by giving the polar coordinates (r,θ) of the target. If the target is hit, points are given to the student with the goal being to win 4000 points in 20 shots. Some targets are worth more than others, based on the difficulty of the coordinates and the size of the target. Figure 46 shows the result of hitting a target with coordinates (60,70).

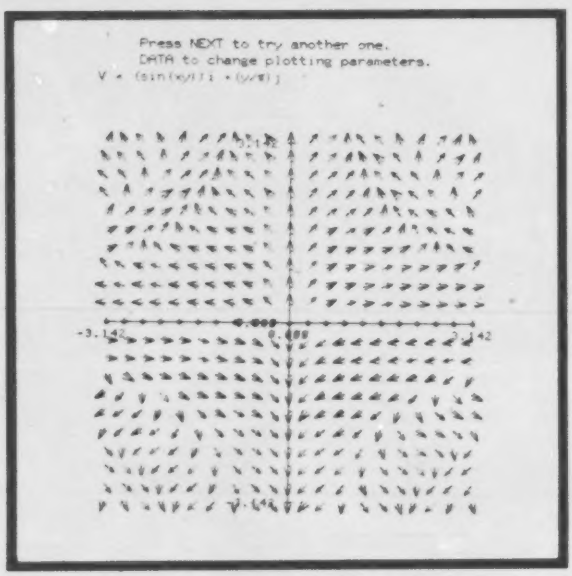


Figure 45. Vector Field Plotting, by Morris Brooks. Copyright © 1978 by the University of Delaware PLATO Project

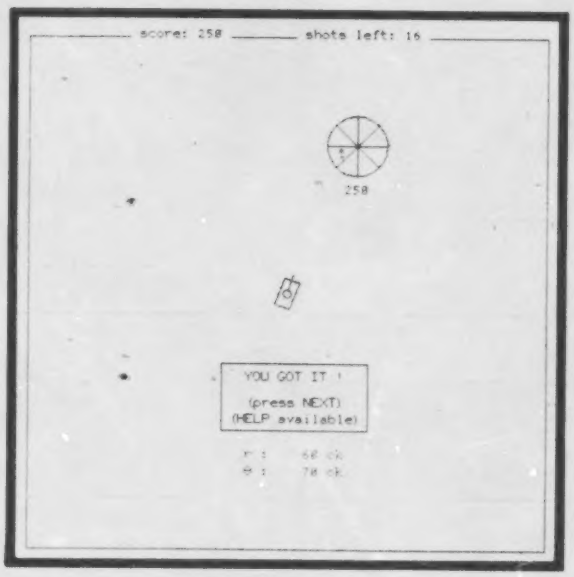


Figure 46. Polar Coordinate Game, by Morris Brooks. Copyright © 1978 by the University of Delaware PLATO Project.

Faculty members in the areas of clothing construction, home economics education, foods, interior decoration, retailing, and flat pattern have become interested in the teaching and research potential of the PLATO system. Prior to the start of their project the only home economics lesson on the system dealt with nutrition. At the present time they are developing lessons in both measurement, pattern measurement, ease requirement, alteration practice, fitting, determining pattern size and figure type, and determining needed alterations.

One of their criteria in lesson development has been to make full use of the special features of PLATO. The touch panel is used in teaching the location of body measurements. In this lesson the student is presented with a line drawing of a human body. The student is instructed to touch the screen to indicate the beginning and ending points for the requested measurement, as shown in Figure 47. If the cursor which appears on the screen is not exactly where the student wishes it to be, the student can move the cursor by pressing any one of the eight directional keys.

Microfiche slides will be used to teach students how to determine needed alterations. Ill-fitted garments will be projected on the screen, and the student will be asked to identify and correct the problem. If the student answers correctly, the correct fit will be shown. In some cases, the results of incorrect answers can be shown as well. Figure 48 shows the measurement chart which students fill in to determine what alterations they need.

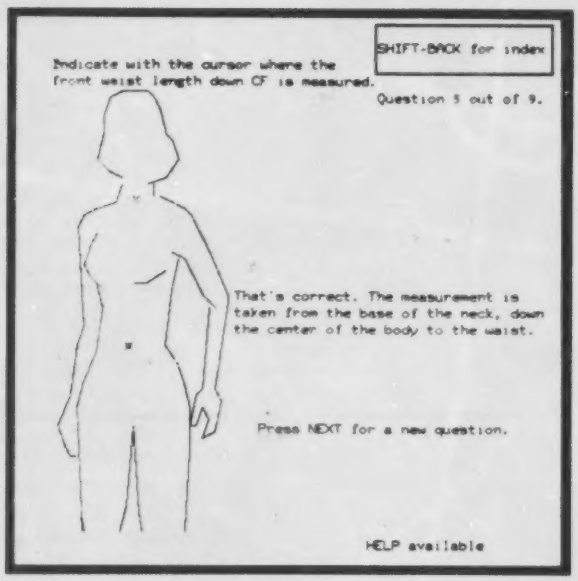

SHIFT-BACK for index
Indicate with the cursor where the front waist length down CF is measured.
Question 5 out of 9.
That's correct. The measurement is taken from the base of the neck, down the center of the body to the waist.
Press NEXT for a new question.
HELP available

Figure 47. Body Measurement, by Dorothy K. Elias, Frances W. Mayhew, and Frances K. Smith. Copyright © 1976 by the University of Delaware PLATO Project.

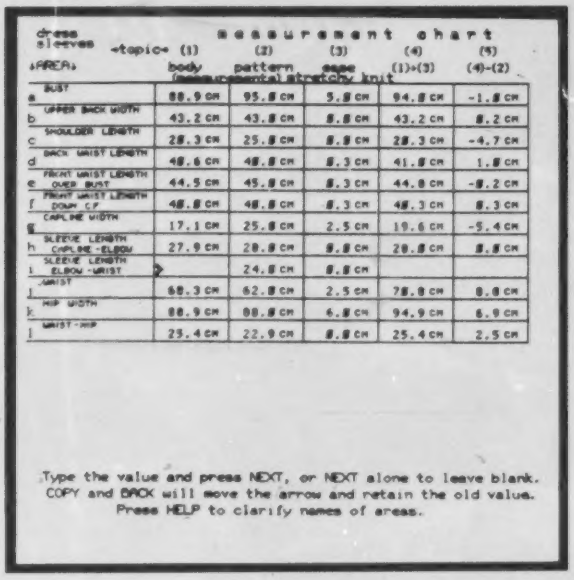

measurement chart
dress sleeves
topic (1) (2) (3) (4) (5)
AREA body pattern ease (1)-(3) (4)-(2)
(measurements stretchy knit)
a BUST 88.9 CM 95.8 CM 5.8 CM 94.8 CM -1.8 CM
b UPPER BACK WIDTH 43.2 CM 43.8 CM 8.8 CM 43.2 CM 8.2 CM
c SHOULDER LENGTH 28.3 CM 25.8 CM 8.8 CM 28.3 CM -4.7 CM
d BACK WAIST LENGTH 48.6 CM 48.8 CM 8.3 CM 41.8 CM 1.8 CM
e FRONT WAIST LENGTH OVER BUST 44.5 CM 45.8 CM 8.3 CM 44.8 CM -8.2 CM
f FRONT WAIST LENGTH DOWN CF 48.8 CM 48.8 CM 8.3 CM 48.3 CM 8.3 CM
g CAPLINE WIDTH 17.1 CM 25.8 CM 2.5 CM 19.6 CM -5.4 CM
h SLEEVE LENGTH CAPLINE-ELBOW 27.9 CM 28.8 CM 8.8 CM 28.8 CM 8.8 CM
i SLEEVE LENGTH ELBOW-WRIST 24.8 CM 8.8 CM
j WAIST 68.3 CM 62.8 CM 2.5 CM 78.8 CM 8.8 CM
k HIP WIDTH 88.9 CM 88.8 CM 6.8 CM 94.9 CM 6.9 CM
l WAIST-HIP 23.4 CM 22.9 CM 8.8 CM 25.4 CM 2.5 CM
Type the value and press NEXT, or NEXT alone to leave blank.
COPY and BACK will move the arrow and retain the old value.
Press HELP to clarify names of areas.

Figure 48. Determining Needed Alterations, by Dorothy K. Elias and Frances K. Smith. Copyright © 1976 by the University of Delaware PLATO Project.

Languages faculty members have worked very hard to successfully improve instruction in Latin, Spanish, French, and German. A problem common to courses in all four of these languages is the wide variation in knowledge of English grammar possessed by beginning students. About half of the students do have an adequate knowledge; but many of the others are so weak in English grammar that they need an intensive review of English before they can begin to learn a foreign grammar. In order to solve this problem the languages department has programmed an English grammar review for those students who need it. Part of the review consists of substitution drills, such as the one shown in figure 49. PLATO gives the student a sentence such as "Sam got lost in the fog yesterday." PLATO then changes the word "yesterday" to "tomorrow" and asks the student what other words need to be changed to fit the substitution. In this case the word "got" needs to be changed to "will get."

The languages department is also using PLATO to deliver instruction in foreign languages themselves. Figure 50 shows a sample Latin translation question. The student has been asked to translate the sentence "Senectus est loquacior." The student's answer is "Old age, rather, is talkitive." Notice that instead of just telling the student that the answer is wrong, PLATO gives the student information regarding why the answer is wrong and what must be done to fix it. The △ before the word "rather" means that a word is missing here. The ⇐ under the word "is" tells the student that the word is out of order, and should appear earlier in the sentence. The equal signs under the word "talkitive" means that it is misspelled.

Translate the sentence into English. Use vocabulary supplied.
(12 to go)
Senectus est loquacior.
> Old age, rather, is talkitive. no
Press DATA if you want to see the answer.
senectus,-us(m)=old age
esse=to be
loquax,loquacis=talkative

Figure 49. Substitution Drill Maker, by Dan Williams. Copyright © 1976 by the Delaware PLATO Project.

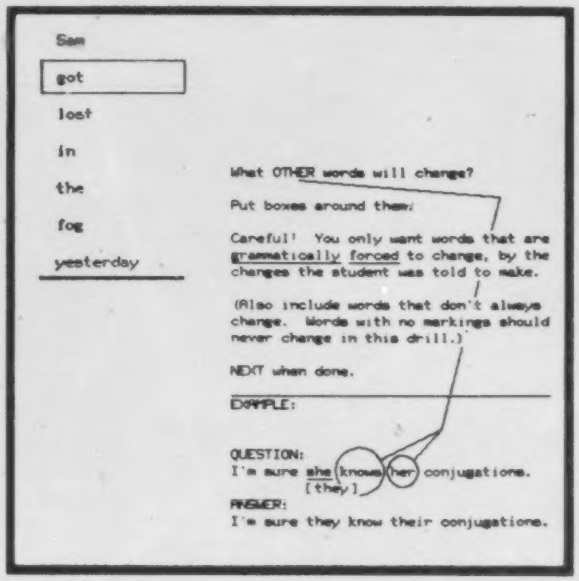

Sam
got
lost
in
the
fog
yesterday
What OTHER words will change?
Put boxes around them.
Careful! You only want words that are grammatically forced to change, by the changes the student was told to make.
(Also include words that don't always change. Words with no markings should never change in this drill.)
NEXT when done.
EXAMPLE:
QUESTION:
I'm sure she knows her conjugations.
[they]
ANSWER:
I'm sure they know their conjugations.

Figure 50. Beginning Latin, by Richard T. Scanlon. Copyright © 1976 by the Board of Trustees of the University of Illinois.

Professor Gerald Culley has recently completed the development of a new Latin verb-form drill called "The Verb Factory." The main feature of this lesson is the interactive help which PLATO gives in helping the students get the right answer. In Figure 51, PLATO has asked the student to write in Latin the phrase "You (singular) are well." The student has responded by answering "valetis," and PLATO has judged the answer incorrect, stating that the stem, vowel, tense, and mood are okay, but the personal ending is wrong. If the student encounters severe difficulty in getting the right answer, PLATO takes him through a check list of grammatical components to help him isolate where his problem is, and the Verb Factory manufactures the correct verb form, one part at a time.

The Verb Factory also contains a Latin verb speed-game called the "Cursus Honorum." The Cursus Honorum allows the student to set switches in the Verb Factory by touching boxes on the display screen, thereby choosing the vocabulary and the verb forms for the computer drill. PLATO proceeds to generate the exercises according to the parameters set by the student. PLATO keeps score based on student response time. In Figure 52 the student has been asked to write the third person plural present active indicative form of "iacere," and the student has correctly entered the answer "iaciunt." The student received 241.4 points for the speed with which he answered the exercise, giving him a total number of 1,325 points, which is displayed at the top of the screen along with the ranks which the student has achieved in the Cursus Honorum.

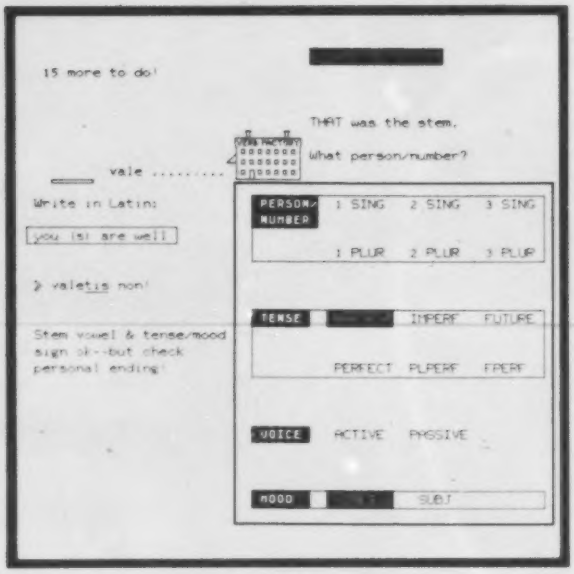


Figure 51. The Verb Factory by Gerald R. Culley. Copyright (c) 1978 by the University of Delaware PLATO Project.

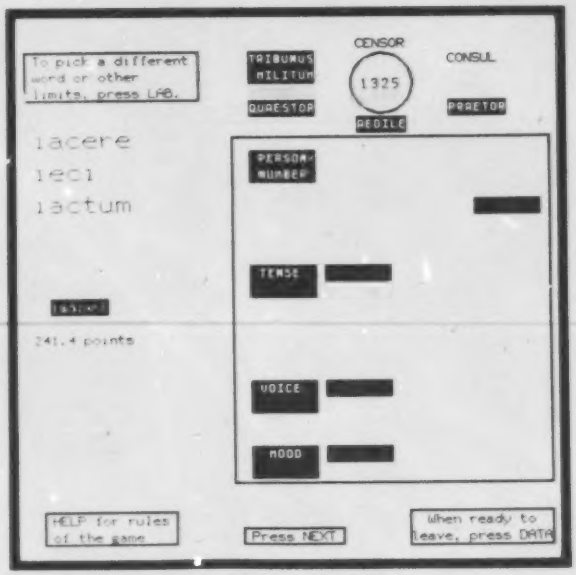


Figure 52. Cursus Honorum: A Latin Verb Game by Gerald R. Culley. Copyright (c) 1978 by the University of Delaware PLATO Project.

Figure 53 is from a lesson which teaches Spanish culture--in Spanish! The lesson begins with a simple vocabulary which grows and becomes more complex as the semester progresses. New words appear with numbered superscripts. If the student doesn't know the word, he can type the number associated with the word to learn its meaning. The student is tested from time to time on his knowledge of Spanish vocabulary and cultural heritage.

The language courseware has also demonstrated a distinct advantage of the PLATO system, namely, its flexibility of educational delivery. One of our students expressed a need to learn Chinese, a course for which there was not sufficient student demand to offer in the curriculum. That student was able to fulfill his specific learning need by taking a course in Chinese at a PLATO terminal.

Figure 53 . Introduction to Spanish Culture, by Armando Armengol and Brian Dutton. Copyright © 1976 by the Board of Trustees of the University of Illinois.

The University of Delaware's entering freshman class is above the national average for college-bound seniors on both the SAT-Verbal and SAT-Math scores. Yet as these students review high-school mathematics topics in beginning college math courses, forty percent of them receive D or F grades or withdraw. As part of a continuing effort to meet this problem head-on, the Math Department introduced PLATO into its pre-calculus offerings during the Spring Semester of 1978. Students were encouraged to make use of PLATO lessons developed at the University of Illinois to improve their ability in manipulating algebraic expressions, solving linear and quadratic equations, utilizing trigonometric relationships, and graphing straight lines.

The mathematics lessons consist primarily of drill-and-practice exercises with tutorial introductions. Figure 54 shows a sample display from a lesson which allows students to practice the series of steps necessary to solve a complicated equation in one variable. Students may request that PLATO guide them through the necessary steps and perform all the calculations, or they may choose to specify all the steps and do the calculations themselves. In this case the student has worked two steps of a problem, and in answer to PLATO's question as to what should be done next, the student has responded "combine left." PLATO indicates that the student must first expand the term with parentheses.

Figure 55 shows a sample display from a lesson on the y-intercept. PLATO presents open linear equations for students to complete as they wish, and then the graphical representations of the finished equations are displayed. Three lines have been displayed corresponding to the numbers 4, 0 and -2, which the student has typed into the equation.

Figure 54. Equations with Fractions, by Mitsuru Yamada. Copyright (c) 1976 by the Community Colleges of Chicago.

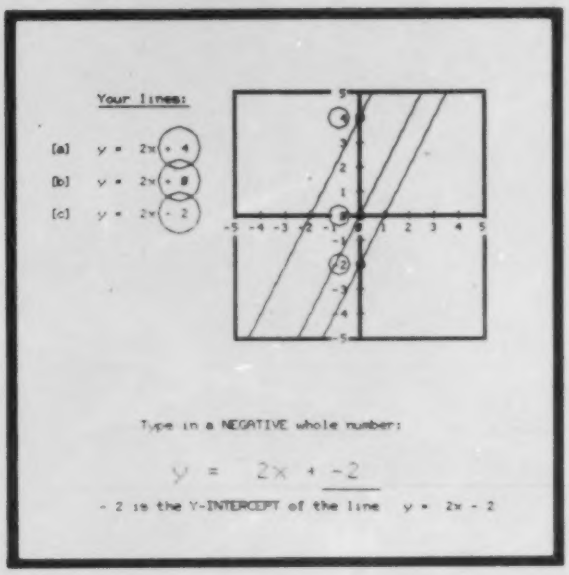


Figure 55. Intercept of a Straight Line, by Barbara Lederman. Copyright (c) 1976 by the Board of Trustees of the University of Illinois.

-Military Science-

The Military Science Department is using PLATO in senior level courses which stress empirical analysis of data bases. The students have a wide variety of entry level skills. Some are able to handle fairly sophisticated statistical problems; others have never had a statistics course before. PLATO helps the less experienced students bring themselves up to the class standard.

Students are using two types of PLATO lessons. First, tutorials are helping them learn how to do statistics, such as the example shown in Figure 56, where the learner is asked to find the mode of a group of test scores from a list and also from a graph. Second, PLATO's computational packages are helping the students perform statistical analyses of their own data.

The department is now developing a package to teach a particular problem-solving heuristic employing quantitative analysis. Known as "The Yellow Brick Road," it will enable students to work assigned military science problems or to solve their own problems. In Figure 57, the student is presented with data in order to determine whether it is cheaper to move an armored battalion by road or by rail. The program will connect to PLATO's existing instructional and computational statistical packages.

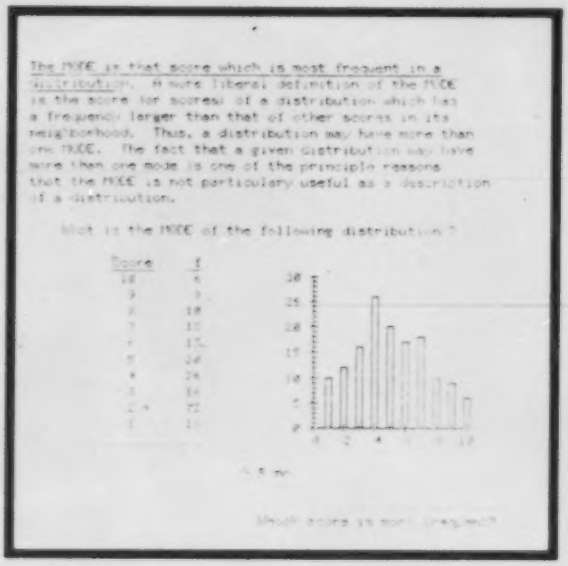

The MODE is that score which is most frequent in a distribution. A more liberal definition of the MODE is the score (or scores) of a distribution which has a frequency larger than that of other scores in its neighborhood. Thus, a distribution may have more than one MODE. The fact that a given distribution may have more than one mode is one of the principle reasons that the MODE is not particulary useful as a description of a distribution.
What is the MODE of the following distribution?
Score
f

Figure 56. Descriptive Statistics, by Jerry L. Cohen. Copyright © 1974 by the Board of Trustees of the University of Illinois.

Figure 57. The Yellow Brick Road, by Lt. Col. George Bailey and Capt. Tom Reinhardt. Copyright © 1978 by the University of Delaware PLATO Project.

The music department has developed a package of ear-training programs called "GUIDO." Guido d'Arezzo is the eleventh century musician and music educator who invented the staff and established the principles of solmization. The ear-training programs are named after him, using his first name as an acronym for Graded Units for Interactive Dictation Operations. The entire first year of ear-training materials has been organized according to levels of difficulty into graded units which form the basis of a competency-based curriculum including drill and practice in intervals, melodies, chords, harmonies, and rhythms. Ear-training students spend an average of two hours each week at GUIDO learning stations which consist of a PLATO terminal and a digital synthesizer designed and developed by Sherwin Gooch at the University of Illinois.

The basic design of the GUIDO programs consists of a three-part process whereby PLATO first displays an answer form on the terminal screen, second, plays a musical example using the digital synthesizer, and third asks questions about the students' perception of the example. PLATO keeps track of how well the students are doing and issues weekly progress reports to the instructors.

Figure 58 shows a sample display from the intervals program. By studying this display the basic features of the GUIDO system can be understood. At the top are two rows of boxes which contain the names of musical intervals. When the student wants to hear an interval, all he has to do is touch one of the boxes. When he does, the box lights up and the interval designated by the box is played by the computer-controlled synthesizer. Conversely, when the student is going through one of GUIDO's formal units, the computer plays an interval, and the student responds by touching the box which contains the interval he thinks was played.

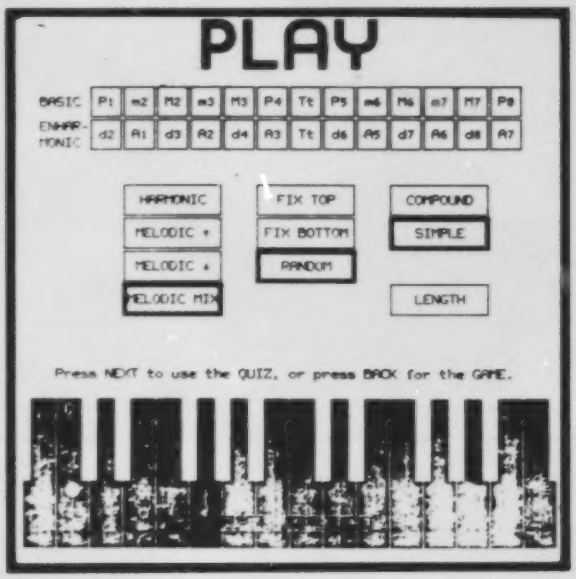


Figure 58. GUIDO Intervals Program,
by Fred T. Hofstetter and William H. Lynch.
Copyright © 1977 by the Delaware PLATO Project.

Underneath the interval names are three columns of teacher or student control boxes. These boxes are used to control the way in which dictation is given. The teacher can preset them for the student, or the teacher can allow the students to set them at will. The first column of boxes allows for the intervals to be played as harmonic, melodic up, melodic down, or melodic intervals up and down. The second column gives the option of being able to fix the top or bottom note of the intervals, or to have them selected at random. The box marked "intervals" allows the student to eliminate intervals from the boxes at the top of the screen, so that only some of the intervals will be played. In the third column of boxes the student can select compound or simple intervals, can have an interval played again, and can change the length of time the intervals last. Finally, there is a keyboard at the bottom of the screen. When intervals are played in formal units one of the notes of each interval is shown on the keyboard, and the student is asked to touch the other note played in the interval. In this way, students are quizzed on the spelling as well as on the aural recognition of intervals.

During the Spring of 1978, the Music Theory Department received a grant from the University's Center for Teaching Effectiveness to support the reorganization of the core music curriculum around PLATO's computer-managed instruction system. According to this system learning objectives and test instruments are being developed for each individual learning module in the core music courses. The objectives, tests, and student learning aids are being typed into the computer-managed instruction system which will keep track of how well the students are doing on the tests. Making use of the information being entered into the system by the music theory faculty, PLATO will be able to advise the students as to what tests they should take and what learning techniques they should try if they should happen to fail a test. The use of the system will have several advantages for both the teachers and the students. The students will be able to go through the curriculum at their own individual learning rates, and PLATO will make sure that they do not get into difficult materials before they are ready. The faculty members will be freed from the large amount of record keeping and testing required in the course, and they will be able to replace many of their lectures and classroom drills with more creative activities.

Figure 59 shows a sample interaction between the student and the computer-managed instruction system. PLATO is telling the student that it is time to find out whether he can identify pitches in treble, bass, alto, and tenor clefs. The student is given the option of studying from the textbook first in order to learn pitch identification, or if he feels confident that he already knows the material, he can go ahead and take a drill on pitch identification. In a traditional classroom setting, the student would have been subjected to more instruction on clefs whether he already knew the material or not. In this case, if the student passes the test, he will not have to spend time listening to the presentation of material which he already knows. Figure 60 shows a display from a sample test administered by the computer-managed instruction system. Notes are randomly generated and displayed on a staff, and the student is asked to respond as quickly as possible by touching the answer box containing the appropriate pitch name. On this particular test, the student must answer nine out of ten questions correct with an average response time of less than three seconds per question.

LR • 1 -- Pitch Identification
If you know what the treble, bass, alto, and tenor clefs are, you probably do not need instruction on clefs. If you do want instruction on clefs, please read Chapt. 2, pp. 18-28 in the Basic Materials book by Paul Harder. Otherwise choose to take the drill lesson on pitch identification.
LAB - to take this CAI lesson.
BACK for your assignment again.

Figure 59. Pitch Identification Module from the Competency-Based Music Education Program, by Michael Arenson, Robert Hogenson, Fred Hofstetter, and Michael Zinn. Copyright © 1978 by the University of Delaware PLATO Project.

PITCH IDENTIFICATION TEST
You'll now receive a series of questions involving the tenor clef. When you see the test item displayed, touch the box on the screen corresponding to the correct pitch. Work quickly and accurately. When you make a mistake, a small arrow points to the correct answer. You must identify the pitch to continue.
C
D
E
F
G
A
B

Figure 60. Pitch Identification Test, by Peter J. McCarthy and Deborah Braendle. Copyright © 1977 by the University of Delaware PLATO Project.

-Nursing-

The College of Nursing is realizing the potential of PLATO to deliver instruction in courses dealing with adult physical health and illness, maternal and child health nursing, and adult acute physical illness. Through membership in PLATO's Health Science Network, the College is using programs developed at the University of Illinois, Sheppard Air Force Base, the University of Oklahoma, and Parkland Community College. The college is also developing its own programs for educating nurses in the care of clients and families with a variety of problems and the handling of emergency situations.

The nursing programs include both tutorials and simulations. Figure 61 shows a sample display from the tutorial on the problem oriented medical record. PLATO guides the students through a sequence of these tutorials, which develop skill at gathering and classifying information important to the care of people. Physical examinations are simulated in the computer. For example, Figure 62 shows how the student can stimulate eyes and observe the pupillary eye reflex. The student can also practice caring for the patient in a simulated environment.

sobjcoff
In response to your first question, Mrs. Patience says, "I've been coughing up blood!" Is that SUBJECTIVE or OBJECTIVE information? ("s" or "o")
? s
Right! She's TELLING you about her problem. This is HISTORY.
-HELP- is available.

Figure 61. Problem Oriented Medical Record, by David Stutz and Jim Romancheck. Copyright © 1976 by the School of Health Care Sciences, Sheppard Air Force Base.

RIGHT EYE
LEFT EYE
STIMULUS
Press the number of the eye you wish to stimulate.
? 2 1. left
2. right
You can stimulate the other eye after about 4 seconds.
Press -BACK- when you have finished your exam.
Press -HELP- if you need it.

Figure 62. Pupillary Light Reflex, by A. Marshall, L. C. Helper, and John Silver. Copyright © 1974 by the Board of Trustees of the University of Illinois.

By using PLATO the nursing students practice assessing, planning, implementing, and evaluating a client/family centered plan which often cannot be found in the hospital on a regular basis. Emergency experience is simulated in a real life environment where every second counts. Students get to try out many methods of intervention, and can compare the results. They can care for the same patient several times, since the patient is simulated in the computer.

70

-Physical Education-

During the 1977-78 academic year, the Division of Physical Education completed the development of its first two PLATO lessons. The first lesson teaches volleyball strategies. Quantitative measures of student achievement had shown that physical education students were not grasping the fundamental volleyball strategies that were being taught in lecture classes. Thinking that this was due to the limited amount of experience which the students were able to get in practicing the strategies in actual volleyball games, it was decided to use PLATO to teach volleyball strategies in a simulated game environment. The volleyball lesson begins with a tutorial on each volleyball strategy. After the tutorial, PLATO sets up the volleyball court and tells the student what the opposition is about to do. Then the students position their players on the court by touching the display screen. When the student is finished setting up the players, PLATO judges the positioning and gives the student feedback on the set up. In Figure 63 , PLATO has asked the student to set up a defense against a CF s[illegible]ker. The student has positioned the players, and PLATO's comments are shown at the bottom of the display.

The second lesson developed by the Division of Physical Education has led to significant improvement in student achievement, and at the same time, a large reduction in the amount of time taken to complete a project in film motion analysis program. Students come to PLATO with body coordinates of nineteen segmental endpoints which they have acquired through the filming of athletes. Figure 64 shows how PLATO uses the coordinates to provide the student with a graphical representation of the body, location of center of gravity positions, and kinematic compounds of both linear and angular velocities. In addition, PLATO calculates the angles for each vertex. The results of a controlled evaluation of this lesson are given in the evaluation section of this report (below, page 75).

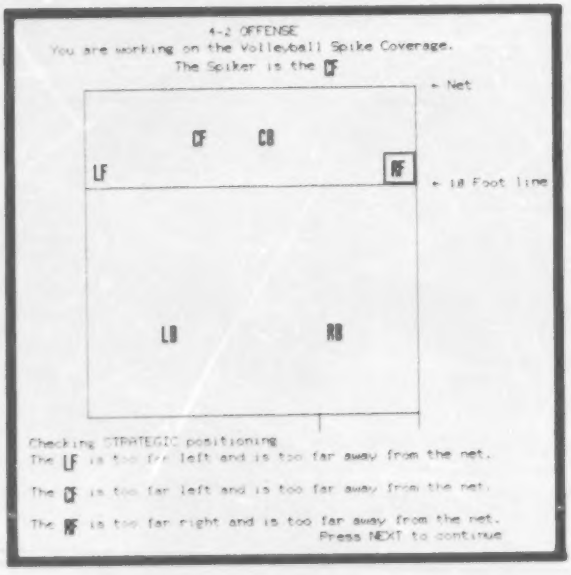

4-2 OFFENSE
You are working on the Volleyball Spike Coverage.
The Spiker is the CF
Net
CF
CB
LF
RF
10 Foot line
LB
RB
Checking STRATEGIC positioning
The LF is too far left and is too far away from the net.
The CF is too far left and is too far away from the net.
The RF is too far right and is too far away from the net.
Press NEXT to continue

Figure 63. Volleyball Strategies, by Barbara Viera and A. Stuart Markham, Jr. Copyright © 1978 by the University of Delaware PLATO Project.

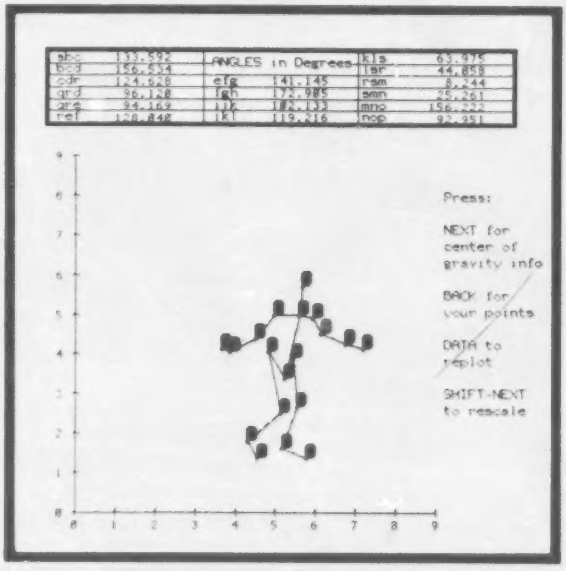


Figure 64. Film Motion Analysis, by David Barlow, James G. Richards, and A. Stuart Markham, Jr. Copyright © 1977 by the University of Delaware PLATO Project.

In addition to the PLATO lesson library for college level courses, many hundreds of hours of pre-college instructional materials exist in the areas of mathematics, English, science, music, human resources, and art. In cooperation with local school districts, four elementary, middle, and high school projects have been initiated to explore the potential of PLATO in a variety of learning situations, including remedial instruction and education for the gifted. In addition, the PLATO Project has sponsored programming courses for high school students and has given many hands-on demonstrations to groups from area schools.

Central Middle School

The Central Middle School Project is a cooperative effort among the Newark School District, the College of Education, and the Delaware PLATO Project. The PLATO classroom in Willard Hall Education Building is made available to 28 sixth grade students and their teacher for an hour every Friday morning. While the students were learning from PLATO lessons selected by their teacher, Mrs. Joan Lindell, undergraduate students from the University's mathematics methods courses observed the students, helped them, and often joined in and played math games with them. In this way, the teachers were able to observe how children learn mathematics, and they could begin to consider the ever-increasing role that computers are playing in education.

According to Mrs. Lindell, the sixth graders took learning from PLATO quite seriously, yet they had fun at the same time. Mrs. Lindell found the lessons on decimals, such as that shown in Figure 65, to be especially beneficial for her class.

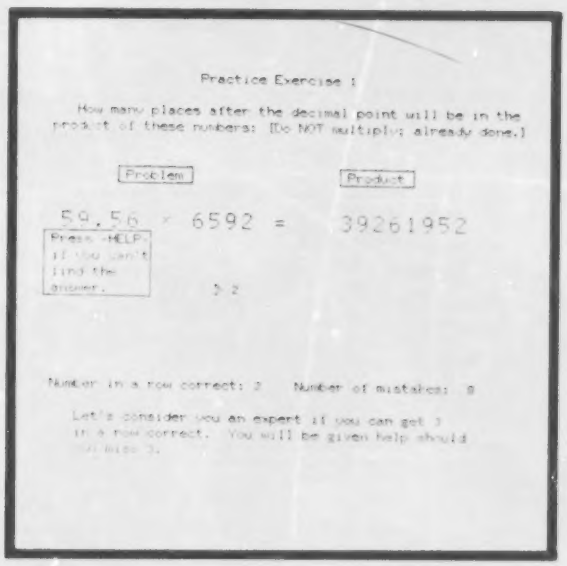

Practice Exercise 1
How many places after the decimal point will be in the product of these numbers: [Do NOT multiply; already done.]
Problem
Product
59.56 * 6592 = 39261952
Press HELP if you can't find the answer.
Number in a row correct: 0
Number of mistakes: 0
Let's consider you an expert if you can get 3 in a row correct. You will be given help should you miss 3.

Figure 65. Multiplying Decimals, by Errol Magidson. Copyright © 1974, 1976 by the City Colleges of Chicago.

In her project report, Mrs. Lindell wrote:

> The posttests at the end of each lesson were of great interest to my students. They liked knowing how well they were doing. I used the posttest scores for the children's report card grades. The children liked this and were very enthusiastic about the decimal unit. I liked it also because PLATO checked the posttests and kept the records.
>
> I taught four sections of sixth grade math. Only one class went regularly to PLATO. Usually in testing and other progress I saw no significant difference between the four classes. However the PLATO group scored much higher on the decimal mastery tests than did the other three groups. I attributed this to the excellent decimal lessons which they had done on PLATO. The children also agreed that they had enjoyed those lessons and had learned much from them.

Mrs. Lindell listed seven additional ways in which her students' PLATO experience enhanced their learning:

1. PLATO minimizes erroneous learning. The children know that if they are doing something incorrectly that PLATO will tell them right away. They do not have to wait until the next day to get back a corrected paper.

2. PLATO offers much flexibility in individualizing instruction. The teacher was able to select lessons to suit the needs of each student--from basic facts to mixed fractions.

3. PLATO helps to develop skills in following directions. While the sixth graders were using PLATO they were more likely to read directions and figure things out for themselves. Because PLATO would tell them immediately if they were wrong, students did not ask the teacher how to do something on PLATO that was clearly explained in the directions; however they did this frequently when using text books or ditto sheets.

4. PLATO enhances the teacher's ability to reach each student by giving the teacher more time to focus on the specific learning needs of each student while PLATO works with the other students, each on a one-to-one basis.

5. PLATO helps students who have very short attention spans. For three students who were easily distracted in the classroom, PLATO was completely engrossing. They seldom noticed what was going on around them in the PLATO classroom.

6. PLATO adds to the intensity and enjoyment of the learning experience. Each day as they drove back to school on the bus, the students' conversations centered on things they had done on PLATO. Their enthusiasm did not wane as the year went on. They were as eager to go to PLATO at the end of the school year as they were at the beginning.

7. PLATO increases parents' interest and involvement in education. Children made use of PLATO on Friday evenings and Saturdays when the PLATO classroom is open to the public. They not only involved their parents but also brought their out-of-town relatives to see PLATO.

A second project involving Central Middle School, the College of Education, and the Delaware PLATO Project provided special PLATO instruction to a group of ten eighth graders who were part of the school district's gifted and talented program. During their weekly sessions in the PLATO classroom, the students completed mathematics lessons that complimented the group's special mathematics curriculum. Somment one student, "I thought the PLATO system helped to quicken my mind."

Upward Bound

During the summer of 1977, the University's Upward Bound program made individualized instruction via PLATO a regular part of its concentrated, on-campus program for academically promising urban high school students. Each student used PLATO in the Willard Hall classroom several times a week for English and/or mathematics.

The objectives set for the PLATO program by Upward Bound's director, William Morris, included:

1. exposure to computers as a learning tool;
2. extensive individualized instruction via PLATO;
3. orientation and training of Upward Bound teachers and aides in the capabilities of computers for instruction, record keeping, and motivation.

Students were individually assigned to lessons by instructors in their regular classes. Some math students used PLATO for algebra while others concentrated on basic skills involving whole numbers, fractions, and decimals. English topics included grammar, punctuation, spelling, and composition. Figure 66 shows how a student is asked to group words beginning with "re" according to the meaning which "re" has in them.

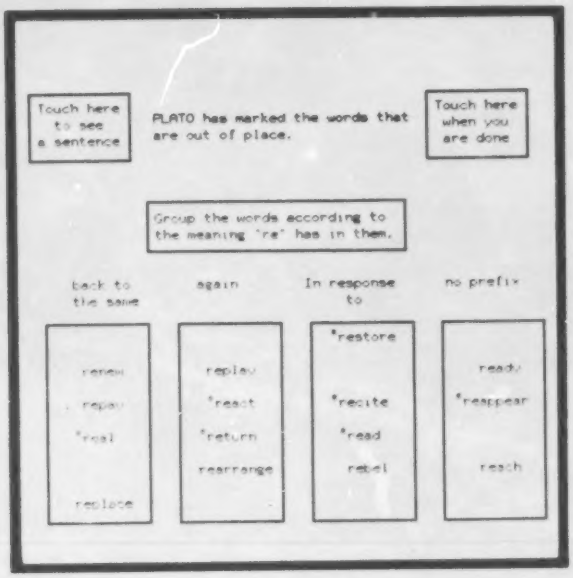


Figure 66. Word Zoo by Steve Hansell and Jessica Weissman. Copyright © 1978 by the University of Delaware PLATO Project.

The English instructors also used PLATO to add a new excitement to communicating; using PLATO's notes sending and receiving capabilities (notesfiles), students wrote notes on-line to their instructors and classmates. Mrs. Joan Nadeau, coordinator of the English program, remarked that this PLATO communication capability increased students' motivational momentum and also gave them an opportunity to generate their own sentences and creatively test their newly acquired language knowledge in grammar, punctuation, and spelling. Observers of the program were especially impressed by the students' intense concentration while working with PLATO.

Mt. Pleasant

Project CHALLENGE, a program for 100 gifted and talented students from grades three through six, made PLATO a part of its innovative curriculum during the Spring of 1978. The purpose of the project was to evaluate PLATO's existing lessonware as to its appropriateness for gifted students in the intermediate grades.

Project CHALLENGE's 100 students were divided into five groups. Each group participated in the CHALLENGE program one day per week. The students spent the remainder of the week in their regular classrooms. The students had ten to fifteen minute sessions on PLATO during their PLATO days.

PLATO was used mainly for enrichment, since students had such limited time on the single terminal. Teachers chose PLATO lessons that complemented topics covered in class. The teachers selected mostly math, art, and music lessons at a variety of instructional levels to accommodate their range of individual differences. One particularly popular lesson, pictured in Figure 67, had students estimate the location of balloons along a number line. Students could formulate answers as decimals or common fractions. When wrong, PLATO showed the students where that number appears on the number line.

Both student and teacher reaction to PLATO was very positive. Students found PLATO exciting; they especially enjoyed the game-like lessons in which their improvement was noted in a high score. Parents were invited to see PLATO too; one parent was very pleasantly surprised at the improvement in attitude that her daughter had toward math because of PLATO.

The teachers arranged a schedule for PLATO use at the beginning of each day; students eagerly looked forward to their turns. They were very concerned about receiving their full ten-minute sessions on PLATO, and they did not want to interrupt their time for anything! One girl needed to go to the restroom while she was on PLATO, but that would have taken two minutes from her session. Unfortunately, after her turn was over, her mother had to bring her a dry set of clothes.

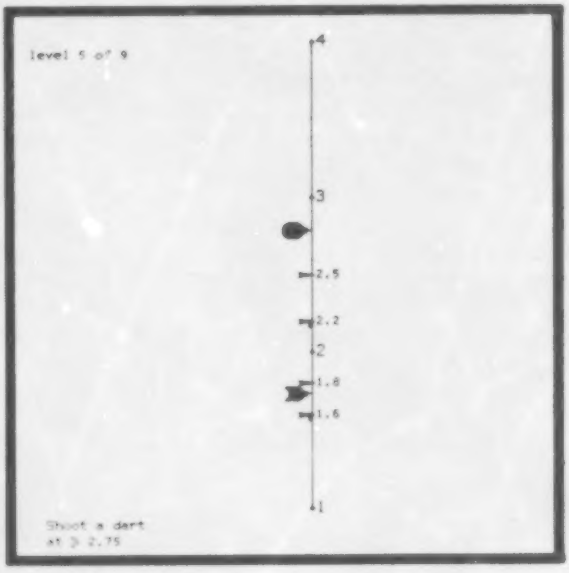


Figure 67. Darts, by Sharon Dugdale, David Kibbey, and Barry Cohen. Copyright © 1975, 1976, 1977 by the Board of Trustees of the University of Illinois.

Project DIRECT

During the Spring of 1978, Project DIRECT, a statewide computer-aided instruction program, located a PLATO terminal in A. I. duPont High School in order to evaluate the benefits of PLATO's pre-college curriculum for use by special education students. Project DIRECT is involved in computer-based education in every school district in the state, as well as in state institutions. Most of this project's use of computers thus far has been with teletype terminals.

Demonstrations were arranged for teachers and students from all grade levels. Approximately 80% of the use was by students, who selected lessons from PLATO's basic mathematics catalog. Figure 68 shows how the game of "Battleship" was used to provide practice in plotting points on the graph. Project DIRECT found that the majority of PLATO lessons at this level combine step-by-step instructions, practice, immediate and meaningful feedback, minimal frustration, and fun, all of which are important ingredients for a special education curriculum. In addition, several students as well as teachers became interested in learning how to program PLATO.

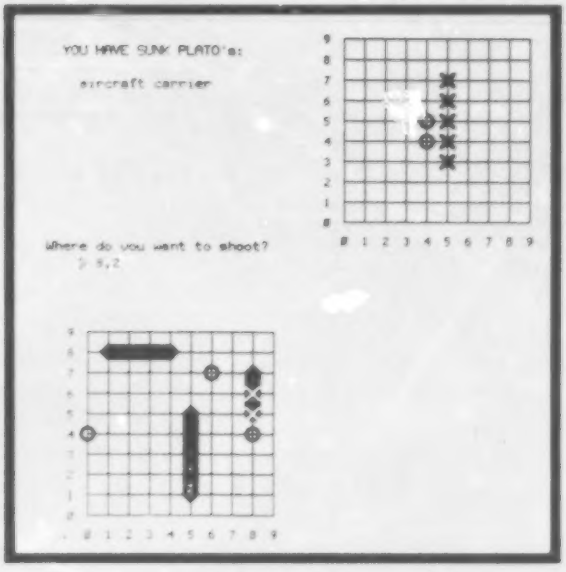


Figure 68. Battleship, by D. Cohen, J. Glynn, L. Bloomfield, B. Anderson, and K. Slaughter. Copyright © 1974 by the Board of Trustees of the University of Illinois.

High School Programming Project

For the past two summers the Delaware PLATO Project has sponsored a five-week TUTOR programming course for high school students. Participants were chosen from Delaware high schools to come to the University twice a week for instruction and supervised programming practice. Many of these students had no prior computing experience or had experience only in BASIC.

During the five-week course each high school student planned and programmed a lesson in an area of personal interest. Lessons programmed by high school students have covered such topics as algebraic equations, units of measurement, and music. Several games have been written, as well as a test grade averager. An instructional lesson on U.S. geography, written by an eighth grade student, is shown in Figure 69. A twelfth grader designed and programmed the tank race game in Figure 70, applying the concepts of angular coordinate systems, generation of random numbers, and rotation of graphics.

Delaware
This is an outline of the mountains of the U.S.
with the west at the left. Delaware is located
at the right.
The name of the mountain chain in the west
begins with an R. What is its name?
Rockies ok
The chain of mountains in the east are called
what? (Hint: It is 11 letters long.)
Alleghany no

Figure 69. United States Geography by Dan Hardy. Copyright (c) 1977 by the University of Delaware PLATO Project.

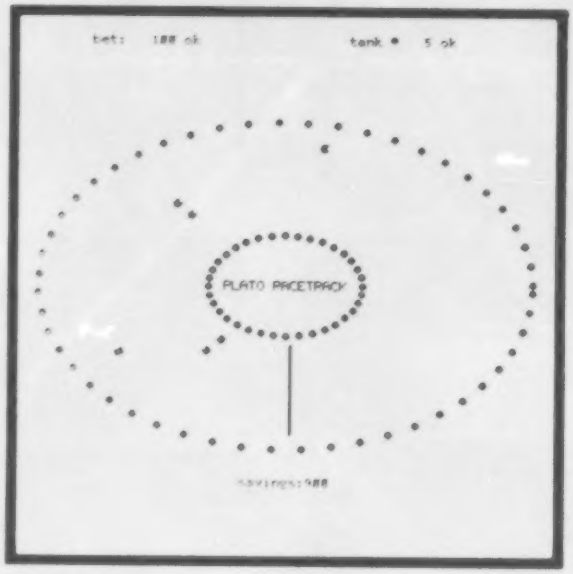


Figure 70. PLATO Racetrack, by John Willoughby. Copyright (c) 1977 by the University of Delaware PLATO Project.

Class Demonstrations and Public Use

During the 1977-78 academic year, teachers of more than 300 pre-college students arranged to have their groups visit the University campus in order to use PLATO. In addition to regular elementary and high school classes, there were groups of students from science clubs, special education groups, gifted student programs, nursery schools, and the Sterck School for the Deaf. Math, English, career education, and art lessons were heavily used.

Many more students used PLATO on Friday evenings and on Saturdays, when the Willard Hall PLATO classroom is open to the general public (pre-college students must be accompanied by a parent). It was a common sight to see a father and son sitting together in front of a terminal playing a math game. One family arranged to have a small birthday party group use PLATO; the birthday girl preferred PLATO to a roller skating party.

Table 6 shows a summary of PLATO use by pre-college students during 1977-78. 262 students used PLATO for a total of 1300 instructional hours.

Table 6

PLATO Use by Pre-College Students During 1977-78

Descriptive Title	Number of Students	Average Terminal Hours per Student	Time of Utilization			
			Summer	Fall	Winter	Spring
Math Lab - Central Middle School	28	12.7		X	X	X
Gifted Student Program - Central Middle School	10	4.3		X		
Upward Bound	39	2.8	X	X		
Project DIRECT	75	3.9				X
Project CHALLENGE	101	1.78				X
High School Programmers	9	35.5	X			

The Psychology Department is investigating two uses of the PLATO system, namely, its use as an instructional delivery system, and its use as a sophisticated research tool. Students in a course on learning and motivation have been using PLATO programs to study multiple probability learning, verbal and non-verbal memory, short term memory, visual imagery, operant conditioning, neural networks, and complex statistical routines. For example, Figure 71 shows how a horse racetrack provides the setting for a lesson on the role of learning in the subjective assessment of probability. The student is provided with three items of information about the contestants in each race, and is asked to bet a variable amount of money. After several races, the student analyzes his performance trends.

Dr. Gary Berg-Cross has developed a lesson which illustrates how simple factors can make problem solving easy or hard. Called "Anagrams," it is intended to be used in courses dealing with cognition and thinking. The lesson discusses two conditions which affect the time it takes to reassemble an anagram into a word, namely, the frequency of the word's usage in published English, and the frequency with which the letter combinations in the anagram occur in English words. PLATO gives the student direct experience of the frequency effects by asking him to solve a few sample anagrams in a timed test. Figure 72 shows the results of a student's being asked to solve the anagram "GANRE." The student answered with the word "ANGER" in 48.99 seconds. PLATO then shows the student how the answer "RANGE," a more frequently used word, is given by the college population in an average time of 8 seconds, whereas the average time for the response "ANGER" is 114 seconds.

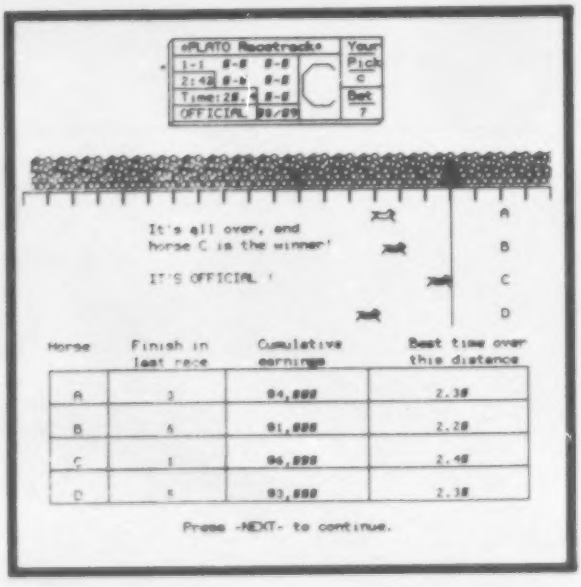


Figure 71. Multiple Probability Learning, by Jerry Cohen. Copyright c 1974 by the Board of Trustees of the University of Illinois.

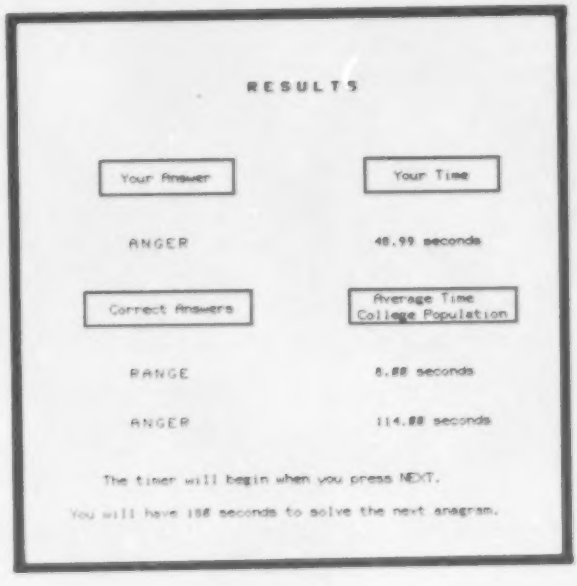


Figure 72. Anagrams, by Gary Berg-Cross and Judith Sandler. Copyright © 1978 by the University of Delaware PLATO Project.

The department is also developing research programs incorporating PLATO as an interactive stimulus-giving, response-storing device. The purpose of the research is to collect information on the strategies used by students in memorizing a large list of words. Students are able to arrange the words at will on the display screen by simply touching a word to "pick it up" and touching a location on the screen to "put it down." The computer will record data regarding the way in which the student arranges the words on the screen, the words that are remembered by the students after a ten-minute study period and then again after one week, and the position on the screen of the words recalled by the student.

During the 1978-79 academic year, two PLATO-based perception laboratories will be installed in the Psychology Department. One will concentrate on aural perception, based around a 16-channel digital synthesizer called the "Synclavier," manufactured by the New England Digital Corporation. By means of an interface to the PLATO system, researchers will be able to write experimental sequences in TUTOR, having PLATO ask questions, store responses, and analyze results, and when it comes time for aural stimuli to be played, PLATO will send the appropriate information by means of the interface to the Synclavier which will then generate the stimuli. The Synclavier is an extremely versatile instrument being capable of generating 16 harmonics for each tone, with complete control over envelope, loudness, frequency, and time. Based on a dual floppy disk system, the Synclavier represents the latest development in microprocessor technology.

The second PLATO-based perceptual laboratory will concentrate on visual studies, and it will contain a high-speed digitizer and a color graphics display system. Psychologists will use the system for a wide range of applications, including studies of binocular vision and neural stimulation patterns in the brain. The visual perception laboratory will be interfaced to PLATO in much the same way as the aural perception laboratory. The digitizer will have an added value for PLATO staff programmers, who will be able to have drawings and illustrations digitized and then used as displays in their PLATO lessons, thereby cutting down the time needed to create complex visual displays.

The Security department is currently using PLATO to supplement its training program for new employees. It is now used exclusively by the Student Service Officers, but future plans include the use of PLATO in all aspects of training in the department. All materials are developed by Security personnel. Through the use of PLATO's computer-managed instruction (CMI) package, PLATO detemines each officer's problem areas and directs him to the appropriate sources for obtaining additional information on those subjects. In many cases the student is sent directly to an instructional lesson on PLATO for remediation; for other deficiencies he is told to study a particular code book or officer manual.

Figure 73 shows a part of the lesson on proper completion of a notice of violation (ticket). The lesson presents the ticket block by block, showing the officer how to fill in the information required for each block. Upon completing the instructional portion of the lesson, the officer is evaluated on his ability to complete an entire notice of violation for each of several simulated traffic violations.

Figure 74 shows how PLATO teaches the aspects of a professional attitude in law enforcement. This is done by simulating a discussion between a lieutenant and an officer who does not understand the concept. It is intended that the officer will learn what is expected of a professional officer by viewing the lieutenant's explanations and seeing the subordinate officer's arguments. This technique not only informs the officer of the correct way to act, but dismisses some misconceptions he might have.

Just to ensure that you understand this procedure, write the time as you would write it on the ticket.
Ten minutes after seven in the morning. 7:10 am ok
Twenty minutes to five in the morning. 4:40 am ok
Nine o'clock in the evening. 9:00 pm ok
Twelve o'clock midnight. 12:00 am ok
Twelve o'clock noon.
NOTICE OF VIOLATION
YOU HAVE VIOLATED THE FOLLOWING

Figure 73. Ticketing by Steve Swain and Raymond J. Schwartz. Copyright © 1978 by the University of Delaware PLATO Project.

Gosher, when are you going to wake up? The only way this department is going to obtain a professional image is for its officers to take a professional attitude toward their actions and appearances.
Press NEXT

Figure 74. Professionalism by John Schimmel and Raymond J. Schwartz. Copyright © 1979 by the University of Delaware PLATO Project.

The Theatre Department is continuing to develop its interactive timeline. The purpose of the lesson is to help students gain a better understanding of the history of theatre and of the historical relationship of theatre to other arts and the sciences. Figure 75 shows a sample display from the timeline lesson. Students touch appropriate places on the display in order to move forward and backward in time, to see events from a particular nation or from a particular discipline, and to specify the level of detail they want. For example, the student can ask what happened in Germany during the Baroque in order to learn the most important events of that period, or they can ask what happened in Germany in 1750 to learn events in a particular year. Students will be able to select a period and then compare what happened during that period among various countries and disciplines. Quizzes will be included in the lesson to measure the students' mastery of the historical periods which they explore.

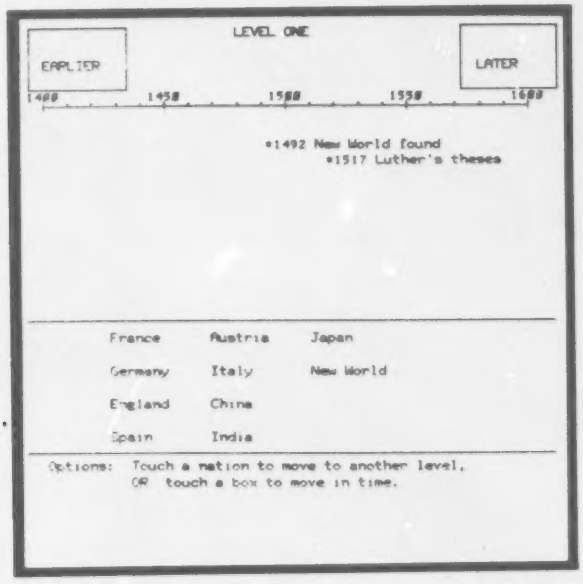


Figure 75. Interactive Timeline by Brian Hansen. Copyright (c) 1977 by the University of Delaware PLATO Project.

CHAPTER III. RESEARCH & EVALUATION

Because of its developmental nature, the Delaware PLATO Project regularly conducts a rigorous internal evaluation. Student opinions are highly valued and are collected in a systematic manner. Controlled experiments are conducted to test the effectiveness of new lesson materials. Project leaders prepare bi-monthly project reports which are used in monitoring program development throughout the year. And a list of the principal values that PLATO has for the University is maintained. The manner in which these components interact is explained in the model for project evaluation.

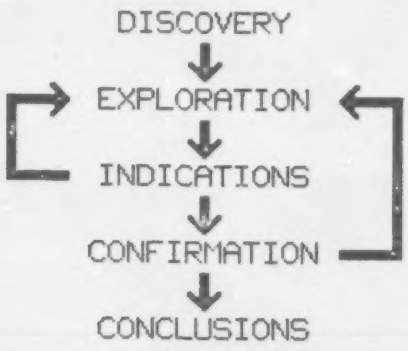
-Model for Project Evaluation-

At our College of Education's recent learning symposium on evaluation, Herbert J. Walberg maintained that the process of inquiry contains five main stages, namely, discovery, exploration, indications, confirmation, and conclusions. Every event in the history of PLATO at our university fits into one of these categories, both at the overall project level and within each individual department. At the project level, PLATO was discovered by our computer assisted instruction committee during the Fall of 1974. The University explored the potential of PLATO during the trial period in the Spring of 1975. Indications were summarized in the report of the Summer of 1975. Confirmation that PLATO has potential for the University was obtained during the 1975-76 and 1976-77 academic years, based on the successful implementation of PLATO in so many departments. The conclusion that PLATO is a worthwhile long-term activity led to the installation of Delaware's own PLATO system during the 1977-78 academic year.

Each department goes through these stages individually when it begins a PLATO project. Discovery usually takes place at one of the periodic PLATO demonstrations, or through a colleague who personally shows his work to a new person. Exploration consists of reviewing existing PLATO lessons, learning about the capabilities of the PLATO system, and reading literature about uses of PLATO. This phase is facilitated by the orientation seminar (above, p. 16), the lesson review process, (above, p. 18), and materials in the PLATO library (above, p.14). Indications are discussed and codified in meetings with peers, PLATO staff members and departmental chairpersons. Confirmation is attained through repeated success of the program in its academic environment. Success is measured through administration of student questionnaries, and through controlled studies of educational effectiveness. A continuous cycle of exploration, indications, and confirmation occurs in most departments, as shown in Figure 76.

Figure 76

Process of Inquiry in Departments Using PLATO



-Student Questionnaires-

A very important component in the evaluation of the Delaware PLATO Project is the opinion of the students. The instructor of every PLATO course is required to have the students complete a questionnaire. Figure 77 shows a standard questionnaire which is given to each instructor as a model for evaluation of PLATO. The instructor can administer the questionnaire as it stands, or he can change, delete, and add items peculiar to his specific course.

During the 1976-77 academic year the student response to PLATO was very positive. Perhaps the two most representative items concerned whether students felt PLATO was an enjoyable learning experience, and whether they felt PLATO was worth the effort. Overall, eighty-nine percent of the students felt PLATO was enjoyable, and eighty-six percent of the students felt it was worth the effort.

Student comments dealt with a variety of topics. They requested more versatility in signing up for time on PLATO, more terminals, and more programs. They asked that lessons developed at other universities be modified to use Delaware terminologies when different terms are used. They want more exercises to practice in preparation for regular hourly exams. They asked that PLATO be used for a greater percentage of their courses. Students commented about PLATO's patience, stating that they were glad that the computer never gets tired of helping them. The most frequent comment concerned the self-paced, individualized learning format. Students feel that PLATO helps them most by providing individualized, immediate feedback to their answers.

Figure 77

STUDENT EVALUATION OF PLATO

Course _____ Instructor _____ Date _____

Please answer the following questions about your experiences with the PLATO system and the lessons which you have seen. Your responses will provide valuable information for evaluating and improving PLATO. Thank you for your cooperation.

Indicate your degree of agreement with each of the following statements by marking:

A = Strongly Agree
B = Agree
C = Neutral
D = Disagree
E = Strongly Disagree

1. Using PLATO was an enjoyable learning experience.
2. The mechanics of using the PLATO terminal distracted me from learning.
3. The major points of the lesson were made clear.
4. The lessons on PLATO were too advanced for our level.
5. I learned what the lessons tried to teach.
6. I already knew the material covered in the lessons.
7. Most of the time the work on PLATO was too easy for me.
8. I was frequently frustrated while working on PLATO.
9. The lessons progressed too slowly.
10. The PLATO lessons were unnecessarily picky about the form of the correct answer.
11. The pace of the lessons was too fast.
12. PLATO is an efficient use of the student's time.
13. PLATO is well suited to presenting instructional material in this subject.
14. PLATO gives the student more feedback than other forms of instruction do.
15. The PLATO lessons helped me learn the material more thoroughly than with other forms of instruction.
16. The lessons made allowances for students with different levels of understanding.
17. A lesson on PLATO is more interesting than traditional instruction.
18. I found myself just trying to get through the material rather than trying to learn.
19. In view of the effort I put into it, I was satisfied with what I learned while using PLATO.
20. Too much class time was spent using PLATO.
21. I would like to spend more class time using PLATO.
22. I would like to take another course which uses PLATO.
23. I was able to schedule enough time each week in which to work.

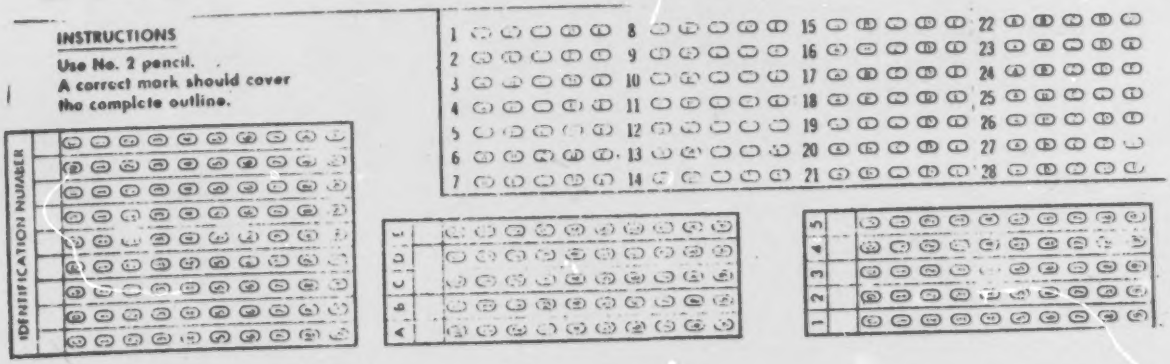


Figure 77 (continued)

24. How many hours have you spent on PLATO in this course? (Circle one)

2 or less | 3-5 | 6-10 | 11-15 | 16 or more

25. Have you used PLATO in any other courses? (Circle one) Yes No

26. Have you ever used a computer (other than PLATO) before? (Circle one) Yes No

If so, in what ways is PLATO different from other computers?

27. What have you liked most about PLATO?

28. What have you liked least about PLATO?

29. What aspects of the PLATO classroom (acoustics, lighting, noise level, policies, staff, etc.) were distracting to learning?

30. What aspects of the PLATO classroom were helpful or conducive to learning?

31. What comments, criticism or suggestions do you have for making more effective use of PLATO in this course.

During the 1977-78 academic year, questionnaire results confirmed the original student opinions expressed in 1976-77. Having determined the overall general student enthusiasm for PLATO, the Delaware PLATO Project began to shift its emphasis from student evaluations of courses as a whole to evaluations of selected lessons in order to learn more about how to design lessons in the most effective manner. For example, it was noted that in one-third of the course evaluations more than fifty percent of the students agreed that the PLATO lessons were unnecessarily picky about the form of the correct answer. An investigation into the nature of the lessons which were causing difficulty for the students revealed that unfavorable ratings were being given most often to lessons that require short answer responses rather than for lessons that require touch or numeric responses. This indicates that designers of lessons which use short answers should carefully consider whether their materials might not be more effectively taught using touch responses or numerical answers, and that if the students are going to be required to type in short answers, the key words used in judging the answers should be as flexiable as possible. The experience gained from this lesson-by-lesson evaluation will provide more sharply focussed information on the reasons why some lessons work better than others.

-Experimentation-

Experimentation in the Delaware PLATO Project has taken three main forms. First, faculty members have used PLATO to do perceptual research, where PLATO serves as a multi-facetted stimulus presentation and response recording device. Second, there are controlled experiments in the effect of PLATO on student achievement. Third, experiments have been conducted into the effects of alternative programming strategies upon student achievement and student attitudes.

In the Department of Educational Foundations, Dr. Victor Martuza has used PLATO in two studies that deal with the perception of graphs, figures, and prose. In the first study, PLATO presents a series of graphs with three independent characteristics three at a time until all possible combinations of three graphs with three dimensions have been shown. For each combination of three graphs, the subject rejects the graph which he perceives as least like the other two. Then all combinations of two graphs are shown, and for each pair the subject rates their similarity on a ten-point scale ranging from "very dissimilar" to "very similar." Finally, the subject is shown four graphs, one of which is a reference graph. The subject is asked to choose which of the graphs is most like the reference graph. An on-line data analysis package has been developed in order to analyze student response data in this study. Consideration is also being given to generalizing the program to facilitate the collection of such data for multi-dimensional stimuli while keeping the programming required for each new study to a minimum.

Dr. Martuza's second study is aimed at determining the best way in which to present graphical materials as illustrations in prose articles. This is of particular importance to writers of textbooks and scholarly articles, where many references are made to graphical materials. A PLATO program has been written which allows the researcher to separate text from figures. The subject is able to read various variable-sized portions of the prose, and he can follow any path in reading the prose. The subject is able to see any one of the figures at any time. Dr. Martuza is using PLATO to save the reading patterns of the subjects as they go through the materials, and he hopes to obtain information regarding the best way to present text and graphical materials for readability and ease of comprehension.

Ms. Aileen Tobin, a graduate student in the Department of Curriculum and Instruction, is working with Dr. Richard Venezky to conduct research on the scanning of letter strings. This study takes advantage of the capabilities of PLATO's microprocessor, because it requires the instantaneous filling of the PLATO screen and the instantaneous erasure and replotting of the screen. Figure 78 shows how PLATO displays a of random letter strings. After the student studies them for a few seconds, PLATO immediately covers them up. PLATO then asks the student to locate the string which has a certain letter in it. Figure 79 shows a display in which the student has correctly located the string which contains the letter "N." All of the student response data is stored on PLATO and is available to researchers at any PLATO terminal. This data is analyzed to plot response latencies on the recognition of random strings of consonants.

Figure 78. Effect of Orthographic Structure on Letter Search, by Dick Venezky, Aileen Tobin and D. G. Anderer. Copyright (c) 1978 by the University of Delaware PLATO Project.

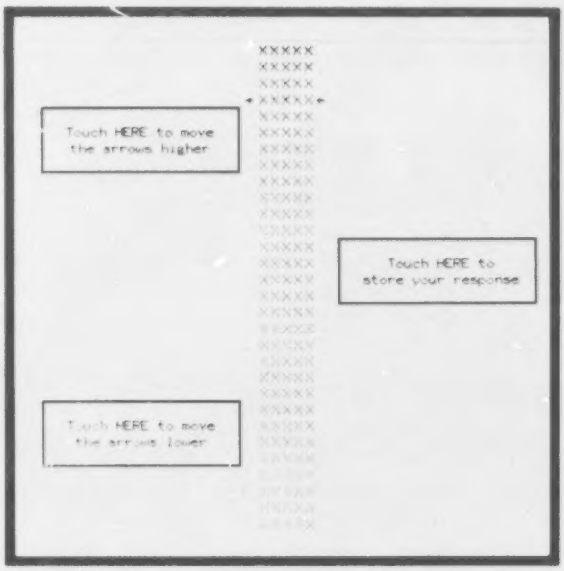


Figure 79. Effect of Orthographic Structure on Letter Search by Dick Venezky, Aileen Tobin and D. G. Anderer. Copyright (c) 1978 by the University of Delaware PLATO Project.

In the Department of Physical Education, Professor David Barlow and Lab Assistant James Richards conducted a study to validate the effectiveness of their film motion analysis lesson, which is described above in the Physical Education project report (page 57).

All undergraduate students in Biomechanics at the University of Delaware during the 1977-78 academic year were randomly assigned to two groups. A control group (N = 46) performed a film motion analysis project in the traditional manner. The experimental group (N = 46) was assigned to use the PLATO System in order to do the same project.

Students of both groups were placed into appropriate laboratory sections. A 16mm Locam Camera (model 164-4DC), set to operate at 100 frames/second, was used to photograph students in the performance of a selected sport skill technique. Appropriate cinematographical procedures were followed to enable the precise assessment of selected kinematic factors of performance. Student topics included sprint starts in track and field, altered slope treadmill running, various jumps in figure skating, grab starts in swimming, and kinematic gait analysis of a thoroughbred race horse.

Initial film measurements of 19 segmental end points of the body were acquired with the use of a Vanguard Motion Analyzer (model M 16-C), a Hewlett-Packard programmable calculator (model 9100B), an automatic digitizer, and a projection system. Ten PLATO terminals were then made available on an assignment basis for students in the experimental group who used the film analysis program to make C/G determinations for up to 10 frames of film. Kinematic components of both linear and angular velocity were obtained at the same time. Aspects of acceleration were also calculated along with measures of angular displacement. Graphic representation of body and C/G positions were then provided in both single and multiple images.

Table 7 shows the results of a multivariate analysis of variance which was conducted to compare selected variables measured for the two student groups. Students in the experimental group completed the project in 58.8% less time than students in the control group. Those students using PLATO required an average of 6.5 hours as compared to 15.8 hours for students in the control group. The F-ratio for this variable was significant beyond the .01 level. In the second variable, identical objective criteria were used to evaluate the project grades for both groups of students. The F-ratio of 19.35 indicated that a definite improvement in quality existed for those projects completed with PLATO.

The non-significant F-ratio obtained for the variable of Course Grade suggested that the two groups were essentially equal in overall capabilities for this study. In summary, use of the film motion analysis program resulted in the following measurable benefits:

1. A considerable decrease in overall data reduction time (58.9%);

2. More accurate data reduction and elimination of measurement error;

3. Increased excitement in the conduct and understanding of biomechanical research.

Table 7

Multivariate Analysis of Variance for Four Selected Variables in Student Control and PLATO Groups in the Physical Education Experiment.

Variable	F Ratio	Significance
1. Project Hours	282.07	$p < .01$
2. Project Grade	19.35	$p < .01$
3. Course Grade	3.40	N.S.
4. Overall Discrimination	73.53	$p < .01$

df = 1,90

In music, an experiment was conducted with the freshman ear-training class in order to determine whether the GUIDO ear-training programs could make a significant impact on student achievement in harmonic dictation. During the first semester, all thirty-three students in the class received the same course of instruction in ear-training with all drill-and-practice done in the tape laboratory. At the beginning of the second semester, the freshman ear-training class was randomly split into two groups; seventeen students were assigned to an experimental GUIDO group, and sixteen students were assigned to a control TAPE group. One of the TAPE students subsequently withdrew from the class, so that the TAPE group was reduced to fifteen students. Each ear-training student spent an average of two hours per week practicing harmonic dictation. Students in the GUIDO group practiced a set of 198 dictation exercises which were typed into the computer from the Benward (1969) Workbook of Ear-Training and the Horacek-Lelfkoff (1970) Programmed Ear-Training series. Students in the TAPE group practiced 281 dictation exercises on the tapes which accompany the same two workbooks. Although students in the TAPE group had 83 more exercises available than students in the GUIDO group, it was assumed that for the purpose of this study the two sets of dictation exercises were basically the same.

Student achievement in harmonic dictation was measured by three tests. The first test was administered at the end of the first semester in order to measure achievement in training in both groups prior to the introduction of GUIDO in the experimental group. The second and third tests were given during the second semester as measures of student achievement in both groups after the introduction of GUIDO in the experimental group. The tests were administered in a classroom situation, and the dictation exercises were played at a piano. All three tests had exactly the same format and were scored as illustrated in Figure 80. The first test covered the triads I, II, IV, V, and VII; the second test, I, II, IV, V, VI, and VII; and the third test, I, II, III, IV, V, VI, and VII. Major and minor keys and triad inversions were included in all three tests.

Figure 80

Test Format and Scoring for the Music Exam

Scoring	Question
Two points for each triad. If the Roman numeral is correct but the inversion is wrong, the answer is considered to be 3/4 correct. Total number of points for this question: 48	1. Each of the following exercises consists of a succession of four diatonic triads. Fill in the blanks with the Roman numeral representation of each triad, including inversions. Each exercise will be played three times. a) ___ ___ ___ ___ b) ___ ___ ___ ___ c) ___ ___ ___ ___ d) ___ ___ ___ ___ e) ___ ___ ___ ___ f) ___ ___ ___ ___
Two points for each triad. If the Roman numeral is correct but the inversion is wrong, the numeral is considered to be 3/4 correct. Each soprano and bass note is worth 1 point. Total number of points for this question: 52	2. Each of the following exercises consists of a succession of seven diatonic triads. Fill in the blanks with the Roman numeral representation of each triad, indicating inversions. In addition, write the soprano and bass lines on the staff. Each exercise will be played four times.

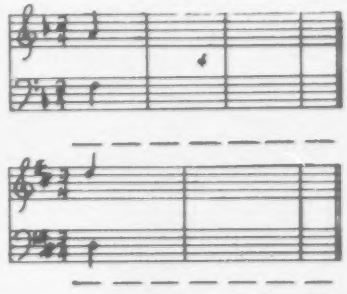



Table 8 contains a summary of the results of the harmonic dictation tests. The mean scores of the two groups were nearly the same on the first test, but on the subsequent tests the means of the GUIDO group were higher.

In order to determine the significance of these differences in test scores, a t-test was used to compare scores of the two groups for each harmonic dictation test. Whereas the scores of the two groups do not differ significantly on the first and second tests, they do differ beyond the .05 level on the third test. Students in the GUIDO group scored higher than students in the TAPE group, indicating that those students using GUIDO's interactive computer program for drill and practice achieved greater harmonic dictation skills than those using the tape laboratory.

Table 8

Comparison of Experimental and Control Group Performance in Music

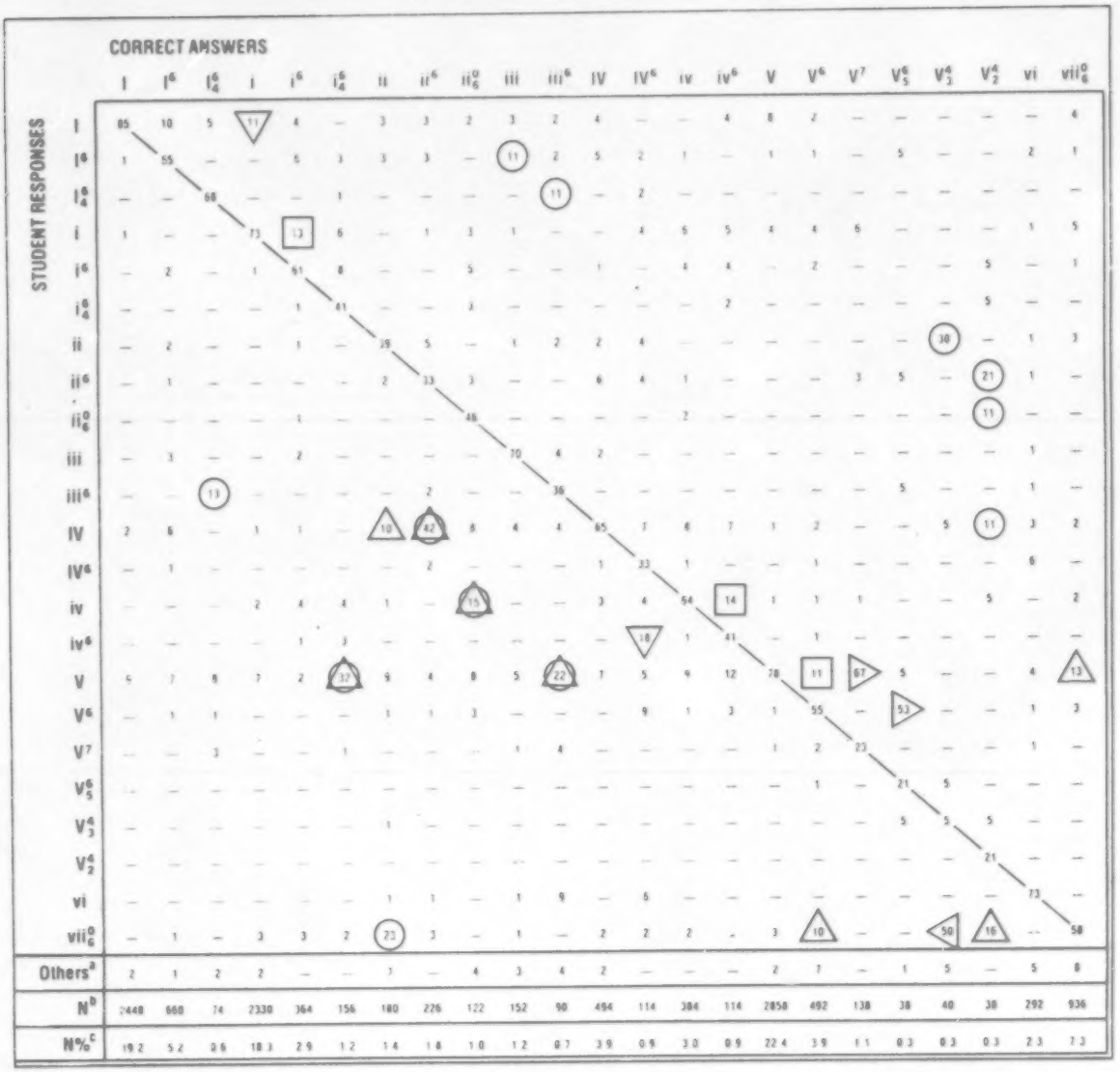
Student Groups	Test 1 (before GUIDO)			Test 2 (after three weeks of GUIDO)			Test 3 (after seven weeks of GUIDO)		
	Mean	Standard Deviation	t	Mean	Standard Deviation	t	Mean	Standard Deviation	t
GUIDO	77	9.9	N.S.	83	13.3	N.S.	86	12.4	$p<.05$
TAPE	76	11.1		75	16.1		75	14.4	

Musicians have known for a long time that confusions of harmonies occur in aural perception. During the summer of 1977, student responses to harmonic dictation exercises in the GUIDO system were analyzed in order to determine whether any student learning problems could be diagnosed. Table 9 shows a cross tabulation for all students and all exercises in the dictation series. Across the top of the matrix are given the correct answers, which appear as Roman numeral symbols commonly given for musical harmonies. Along the left hand side of the matrix are the responses which students gave in the dictation exercises. Numbers in the matrix are percentages of the times the student responses were given. Those numbers appearing on the diagonal represent the percentages of times the students gave correct answers. The other numbers represent incorrect answers.

It was found that by studying the incorrect answers student learning difficulties can be diagnosed. In Table 9, six specific patterns are found. First, there are confusions of harmonies which have the same bass notes. These have been circled. Second, there are harmonies which have been confused with their inversions. These have been marked with a square. Third, there are confusions of harmonies which have the same chord functions. These have been marked with a $\triangle$. Fourth, there are confusions of harmonies which have the same chord qualities. These have been marked with a ∇. Fifth, there are seventh chords which have been missed because of an unperceived seventh. These are marked with a $\triangleright$. Sixth, there are seventh chords which have been confused because of an unperceived root. These have been marked with a $\triangleleft$.

Table 9

Cross Tabulation of Correct Answers and Student Responses for All Harmonic Dictation Units: Numbers Given in the Matrix are Percentages of the times the Student Responses were Given


CORRECT ANSWERS
STUDENT RESPONSES
I I⁶ I⁶₄ i i⁶ i⁶₄ ii ii⁶ ii⁰₆ iii iii⁶ IV IV⁶ iv iv⁶ V V⁶ V⁷ V⁶₅ V⁴₃ V⁴₂ vi vii⁰₆
Others[a]
N[b]
N%[c]

[a] "Others" are responses that were not in the list of possible answers.
[b] "N" is the number of times the chord was asked.
[c] "N%" is the percentage of times the chord was asked.

○ = Bass Line Confusions
□ = Confusions by Inversion
△ = Confusions by chord function
▽ = Confusions of chord quality
▷ = Unperceived seventh
◁ = Unperceived root

Musicians have suspected many of the six response patterns as possible causes for these confusions. What was not known before this study was specifically which harmonies are affected by which confusion tendencies, and how the confusion tendencies interact. A knowledge of the effects of confusion tendencies can help teachers diagnose and understand them when they observe them in their students, and it can also provide important information for the redesign of published ear-training series.

During the 1977-78 academic year, a new programming approach was evaluated by the Music Department. Two groups of freshman ear-training students participated in the experiment. Both groups consisted of twelve subjects, who were given the exact same course of instruction in ear-training, with all drill and practice given by the computer. The only difference was that for one group (the experimental group) a set of competencies was defined and entered into the computer, and the students were not allowed to progress from one unit of instruction to another until they had attained the level of competency required for each unit. The other group of students (the control group) learned intervals in the same sequential manner as they had in the past.

At the beginning of the course, a pre-test was administered to all twenty-four students. The pre-test included four sections, namely, ascending intervals, descending intervals, mixed ascending and descending intervals, and harmonic intervals. Twenty-five intervals of each type were presented for a total of one hundred intervals. The students were ranked in order from one to twenty-four based on their performance on this test. All of the odd numbered students were placed in the competency-based experimental group, and the even numbered students were placed in the sequential control group. At the end of the course, this test was administered to both groups again. Table 10 shows a comparison of achievement scores on the pre- and post-tests for students in both the competency-based experimental group and in the sequential control group.

On the pre-test, the sequential control group had an average score of 72% and the competency-based experimental group had an average score of 73%. The application of a t-test showed that there were no significant differences between the two groups. Results of the post-test showed that both groups improved in their ability to hear intervals. The sequential control group had an average score of 83% whereas the competency-based experimental group had an average score of 94%. The application of a t-test to the post-test scores showed that the competency-based group learned significantly more than the sequential control group.

Table 10

Comparison of Achievement Scores on Pre- and Post-Tests for Twelve Students in the Competency-Based Experimental Group and for Twelve Students in the Sequential Control Group on the Basis of Descending, Mixed Ascending and Descending, and Harmonic Intervals.

Student Groups	Pre-test Scores			Post-test Scores		
	Mean	Standard Deviation	t	Mean	Standard Deviation	t
Sequential Control Group	72	14.1	N.S.	83	14.3	$p<.05$
Experimental Competency-Based Group	73	8.7		94	4.1	

Finally, a controlled experiment was conducted in languages. Two sections of an elementary Latin course were used, with one section constituting an experimental PLATO group and the other section a CONTROL group. Both sections met in class for the normal three 50-minute periods per week. The PLATO group spent two additional hours each week at the computer terminals using materials developed by Professor Gerald Culley of our University and by Professor Richard Scanlon of the University of Illinois (above, p. 48). The CONTROL group spent the same amount of time practicing traditional Latin materials.

Student achievement in Latin was measured by four tests. These tests were administered in a classroom situation. The first test covered chapters 1-6 of Frederic Wheelock's Latin: An Introductory Course Based on Ancient Authors (Barnes and Noble, Inc., 1963). The second test covered chapters 7-12. The third test covered chapters 13-18. The fourth test covered the whole semester, chapters 1-25.

Table 11 contains a summary of the results of the Latin tests. The mean scores of the two groups were nearly the same on the first test, but on subsequent tests the means of the PLATO group were higher.

In order to determine the significance of these differences in test scores, a univariate analysis of variance was used to compare the two sets of test scores. The scores of the two groups do not differ significantly ($p < .45$), although a trend can be observed in the PLATO group where the mean was equal to the CONTROL group score on the first test, 6% higher on the second test, 4% higher on the third test, and 4% higher on the fourth test.

Table 11

Comparison of Experimental and Control Group Performance in Latin

Student Groups	Test 1 (August 4)		Test 2 (August 25)		Test 3 (September 17)		Test 4 (September 22)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
PLATO	86	11.0	84	14.4	79	15.6	78	18.5
CONTROL	86	9.1	78	14.8	75	14.6	74	17.3

-Overall Educational Value of PLATO for the University of Delaware-

As the Delaware PLATO Project has grown from the installation of its first terminal on March 14, 1975 to the purchase of its own PLATO system, and as the number of departments using PLATO has increased from the original three to the present thirty, the faculty and students have identified many benefits of PLATO to the University of Delaware. It is through the realization of these benefits that PLATO has received a widespread support and acceptance at the university. This report concludes with the classification of these benefits according to ten main purposes which are enumerated and explained as follows:

1. To individualize instruction. Faculty members and students often complain that the level of instruction is never right for all members in a class. Some are fast learners; others are slow learners. Some drop out because a course is too boring; others drop out because they can't keep up. The individualized, self-paced approach of PLATO has proven to be a remedy for this problem of individual differences.

2. To expand the university's educational market. The market needs a delivery system which can economically deliver instruction over a wide geographical area. Through computer-based techniques, the university can reach more students. For example, if three people in Georgetown wanted to learn Persian, PLATO could teach them whereas a regular course would be cancelled due to small enrollment. This aspect becomes even more important as the learner population is becoming more adult in its make-up.

3. To reduce the time needed for instruction. Computer-based self-paced techniques make it possible for students to finish courses in less than the normal fourteen-week semester. PLATO could allow students to complete their degree ahead of schedule, thereby reducing the cost of instruction to the parent and to the taxpayer.

4. To emphasize the intrinsic joy of learning and deemphasize competition with peers as a motivating force. In the computer-based environment the anxieties associated with the traditional classroom are minimized. The student is free to respond as he wishes without the fear of ridicule from either his peers or his teacher. In such an environment learning is a lot of fun, and motivation is high.

5. To enable students to develop a richer intuitive grasp of complex phenomena through graphic visual representation. Especially applicable to PLATO is the saying that "A picture is worth a thousand words." The ability of PLATO to create interactively a display suited to the student's specific learning needs cannot be overestimated.

6. To provide students with access to a wide range of data for checking out hypotheses. A good example of this benefit is the population dynamics PLATO program. Stored in the computer are up-to-date data on the populations of countries throughout the world. The student is able to set variables which affect the futures of those populations, such as time and extent of famines, and can then see the effects of those variables upon future generations of the populations.

7. To enable the students to learn more of the complexities of phenomena through modeling and simulation. In addition to giving students drill-and-practice and tutorials on various subjects, PLATO can also allow the student to create models and simulate complex phenomena. For example, the student can make electronic circuits, design clothes, compose music, draw pictures, mix chemicals, breed fruit flies, and then study the results of the models and simulations. Such flexibility is not a regular part of education in university courses; it should be.

8. To encourage students to tailor their learning experiences to meet their own objectives. How often do students complain that they did not get what they wanted out of a course? They may have met the instructor's objectives, but they did not meet their own objectives. PLATO can help them do both. For example, in the university's advanced music theory courses, very little time is spent on set theory. However, some students want to explore it in depth. It is a complex analytical system which cannot be learned by the average student by reading a book. Interactive instruction in this area is made available to the students who want it by means of PLATO's set theory program. There are ten hours of instruction available for students who want to learn set theory, including periodic tests which assure the student that he is mastering the material. In this way, students are encouraged to extend their learning beyond the requirements of the course.

9. To give immediate feedback. One of the greatest advantages of computer-based techniques is immediate feedback. Through individual interaction with the computer, each student partakes in a dialogue in which he receives instantaneous responses to his input. There is no other medium which provides this interaction, a benefit which has led to the documentation of significant improvement of instruction in such diverse areas as anesthesiology, French, music, mechanics, dentistry, sociology, calculus, geography, ecology, health, physics, and accounting.

10. To provide maximum flexibility. Micro-electronic technology has progressed to the point at which practically any electronic device can be connected to a PLATO terminal. The terminal already has a slide projector, a touch-sensitive screen, a random-access audio device, a speech synthesizer, and a music generator. The terminal also contains a microprocessor, the latest development in computer hardware, which secures product flexibility for the foreseeable future.

APPENDIX

Catalog of Programs Under Development in the Delaware PLATO Project

CATALOG OF PROGRAMS UNDER DEVELOPMENT IN THE DELAWARE PLATO PROJECT

-Instructional Lessons-

Department	Title	Developer	Programmer(s)
Agriculture	APS101 Sample Test Questions	Paul Sammelwitz	Paul Sammelwitz
	The Endocrine System	Paul Sammelwitz	Daniel Tripp
	Relations	George Haenlein	Craig Lewis Daniel Tripp
Anthropology	Cellular Structure	Margaret Hamilton	Monica Berrang
Art	Aesthetic Value Inquiry	Raymond Nichols	Joseph Maia
	Composition Using Grey Scale Tones	Raymond Nichols	Joseph Maia
	Design Aesthetics and Creation	Raymond Nichols	Charles Wickham
	Letter Spacing	Raymond Nichols	Charles Wickham
	Newspaper Copy Fitting	Raymond Nichols	Joseph Maia
	Painting on a Computer	Raymond Nichols Ben Williams	Ben Williams
	Rotating Squares Generator	Raymond Nichols James Wilson	James Wilson
	Random Dot Pattern Generator	Raymond Nichols	Klaus Abele
	Slide-Tape Presentation Editor	Raymond Nichols	James Trueblood
	Mechanical Drawing for Students in Graphic Design	Raymond Nichols	Klaus Abele
Chemical Engineering	Expansion of an Ideal Gas	Stanley Sandler	Douglas Harrell
	Introduction to Mass Balance	Robert Pigford	Brian Russell

Department	Title	Developer	Programmer(s)
Civil Engineering	Shear and Moment	Eugene Chesson	Jeffrey Snyder
Counseling	Holland's Self-Directed Search and Career Inventory	Richard Sharf William Mahler	William Mahler Mark Laubach
	Job Aids	Richard Sharf Mark Laubach	Mark Laubach
Economics	Review of Graphing	Karna Mathre James O'Neill	Karna Mathre
Education	Big Story (imitative reading)	Peter Pelosi	Jessica Weissman
	Facts in Reading Comprehension	Frank Murry	Judith Sandler
	Fast Accurate Symbol Transcription for Evaluation of Elementary Reading	John Pikulski	Deborah Braendle
	Make a Spy (Sight word game)	Bonnie Seiler Jessica Weissman	Jessica Weissman
	Metric Estimation Game	Bonnie Seiler James Wilson	James Wilson Bonnie Seiler
	Sight Word Attack Team (SWAT)	Rosalie Bianco Peter Pelosi	Jessica Weissman
	Sight Word Teaching Method Simulations	Peter Pelosi	Jessica Weissman
	Spot the Spy (Sight word game)	Bonnie Seiler Jessica Weissman	Jessica Weissman
	SWAT Missions (Sight word game)	Bonnie Seiler Jessica Weissman	Deborah Braendle
	SWAT Promotion Test	Rosalie Bianco Peter Pelosi	Jessica Weissman
	Word Zoo (classifying prefixes by meaning)	Steven Hansell	Jessica Weissman

Department	Title	Developer	Programmer(s)
Home Economics (Human Resources)	Metric Visualization	Dorothy Elias	Dorothy Elias David Anderer
	Pattern Alteration Simulation	Frances Smith Frances Mayhew Dorothy Elias	Dorothy Elias James Wilson
	Pattern Measurement	Dorothy Elias	Dorothy Elias David Anderer
	Determining Ease	Dorothy Elias Frances Mayhew Frances Smith	Dorothy Elias David Anderer
	Body Measurement	Dorothy Elias Frances Mayhew Frances Smith	Dorothy Elias
	Home Economics Usage Data Display	David Anderer	David Anderer
Languages	The Verb Factory	Gerald Culley	Gerald Culley
	Cursus Honorum: A Latin Verb Game	Gerald Culley	Gerald Culley
	Review of English Grammer	Gerald Culley	Gerald Culley
	Transformation Drill and Editor	Dan E. Williams	Dan E. Williams
	French Word Order Drill	George Mulford	Dan E. Williams
	French Word Game	Christine Brooks	Christine Brooks
	Language Lab Tape Preparer	George Mulford	James Wilson
Mathematics	Vector Field Plotter	Morris Brooks	Morris Brooks
	Polar Coordinate Game	Alan Stickney	Alan Stickney
	Calculus	Morris Brooks Alan Stickney	Alan Stickney Morris Brooks
Military Science	Solving Problems Statistically	Thomas Reinhardt	Michael Houghton Thomas Noyes

Department	Title	Developer	Programmer(s)
Music	GUIDO Ear-Training System:		
	Intervals	Fred T. Hofstetter	William H. Lynch
	Melodies	Fred T. Hofstetter	William H. Lynch
	Chord Qualities	Rosemary Killam	Michael Larkin
	Seventh and Ninth Chords	Fred T. Hofstetter	Michael Larkin
	Harmonies	Fred T. Hofstetter	William H. Lynch
	Rhythms	Fred T. Hofstetter	William H. Lynch
	Fundamentals of Ear-Training	Robert Hogenson	Richard Thomas
	Note Reading Drill and Game	Peter McCarthy	Deborah Braendle
	Set Names (after Forte)	Fred T. Hofstetter	James Trueblood
	Spelling Intervals	Michael Arenson	Richard Thomas
Nursing	Human Heart Valves (adapted from Illinois vet med lesson)	Shirley Cudney	Charles Wickham James Trueblood
	The Nursing Process (adapted from Settlemeyer, University of Pittsburgh)	Shirley Cudney	Charles Wickham James Trueblood
	Simulated Treatment of Diseases	Mary Ann Early	James Trueblood
	Simulation Writer	James Trueblood	James Trueblood
Physical Education	Film Motion Analysis	David Barlow	Stuart Markham
	Volleyball Strategies	Barbara Viera	Stuart Markham
Physics	A Problem in Angular Velocity	Cheng-Ming Fou	Charles Wickham
Psychology	Anagrams	Gary Berg-Cross	Judith Sandler
Security	Ticketing	Steven Swain	Raymond Schwartz
	Professionalism	John Schimmel	Raymond Schwartz

Department	Title	Developer	Programmer(s)
Security (continued)	Motor Vehicle and Bicycle Regulations (PCMI module)	Steven Swain	Raymond Schwartz
	Criminal Code (PCMI module)	Steven Swain	Raymond Schwartz
	Phonetic Alphabet Code for Law Enforcement	Raymond Schwartz	Raymond Schwartz
	Public Safety 10 Code (PCMI module)	Steven Swain	Raymond Schwartz
Theatre	Interactive Timeline	Brian Hansen	James Wilson Michael Larkin
	-Research Programs-		
Art	Statistical Package for Letter Spacing	Raymond Nichols	Charles Wickham
Educational Foundations	Effect of Orthographic Structure on Letter Search	Richard Venezky Aileen Tobin	David Anderer
	Graph Reading	Victor Martuza	James Trueblood
	Reading Studies	Frank Murray	Judith Sandler
Psychology	Memory Experiment	John McLaughlin	Judith Sandler
	-Utilities-		
UDPLATO	Comprehensive Accounting Analysis Package	Charles Wickham James Wilson	Charles Wickham
	Equipment Inventory Programs	Mark Laubach Dan E. Williams	Mark Laubach Dan E. Williams

Department	Title	Developer	Programmer(s)
UDPLATO (continued)	PLATO Users Survey Package		Daniel Tripp
	UD Lesson Catalog Package	Bonnie Seiler David Anderer	David Anderer
	UD PLATO Scheduling Package	Bonnie Seiler David Anderer	David Anderer James Trueblood
	User Directory	Mark Laubach Bonnie Seiler James Wilson	Mark Laubach